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SOIL SURVEY *of* STANSTEAD, RICHMOND, SHERBROOKE *and* COMPTON COUNTIES

IN THE

PROVINCE OF QUEBEC

BY

D. B. CANN and P. LAJOIE

Experimental Farms Service, Dominion Department of Agriculture
in Co-operation with the Quebec Department of Agriculture
and Macdonald College, McGill University.

shed by authority of the Hon. James G. Gardiner, Minister of Agriculture,
Ottawa, Canada

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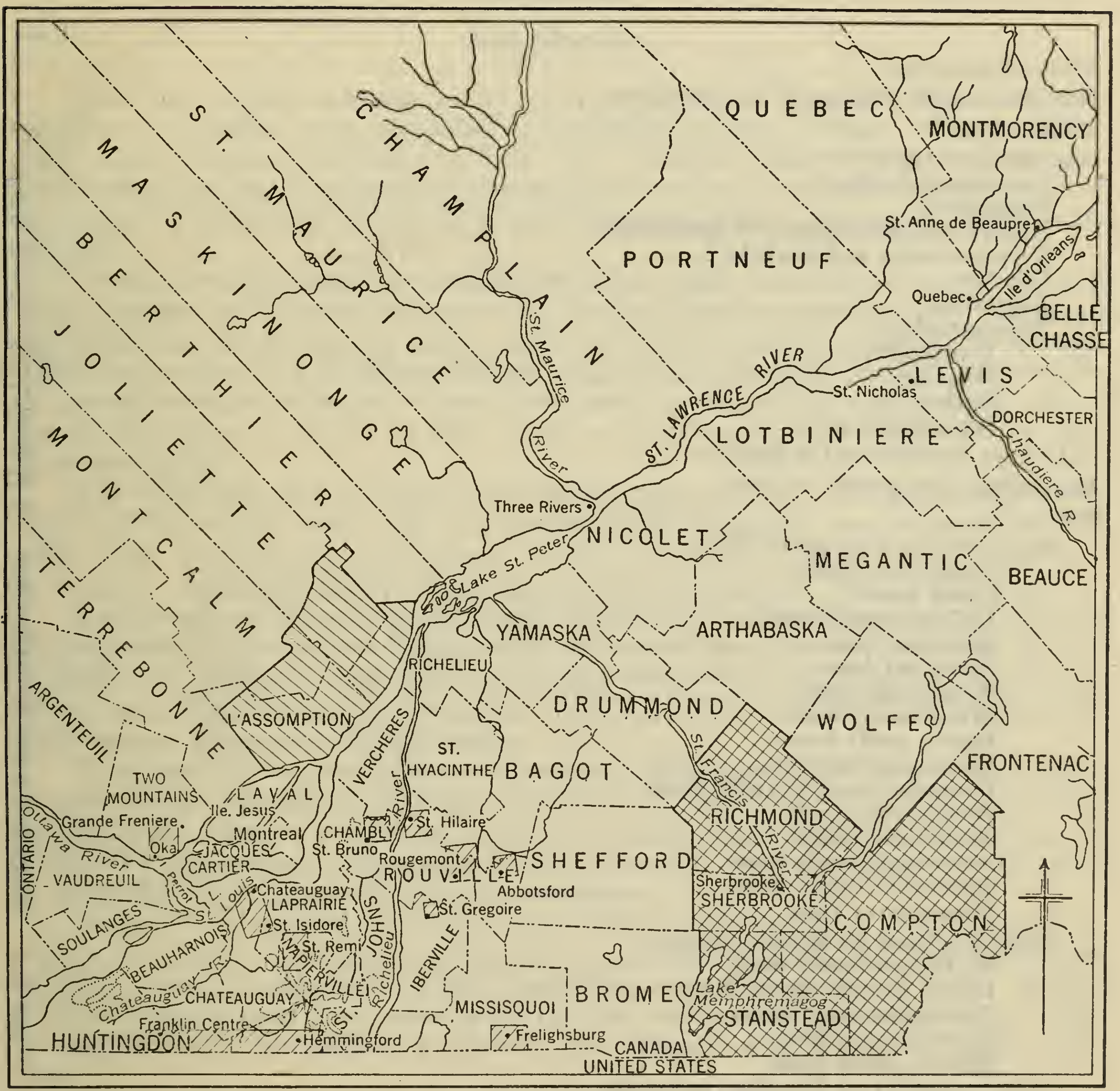

INDEX MAP
OF
CENTRAL QUEBEC
SHOWING LOCATION OF SURVEYED AREAS

LEGENDE	LEGEND
Frontiere internationale	International boundary
Limite de comte	County boundary
Etendues des sols a vergers	Areas of orchard soils
Sols organiques	Organic soils
Region de Joliette-L'Assomption	Joliette-L'Assomption area
Region discutee dans ce rapport	Area discussed in this report

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Introduction

The first report on the soils of the Eastern Townships region of the province of Quebec was published by McKibbin and Pugsley (10) in 1930. This report pointed out that the soils were, in most cases, of low fertility and emphasized the need for further study of the crop and soil relationships within the area. In this connection it is significant to note a quotation from their report.

"The viewpoint must be emphasized that until a soil survey of this and other regions of Quebec province is effected, both practising and technical agriculturists will be largely in the dark as to the underlying factors in specific soils, the causes of soil differentiation and the soil reasons for the adaptation or non-adaptation of crops. Once these facts are known and the proper treatments discovered, solution of field problems can be effected more readily and more certainly."

The need for such a survey has been emphasized by the large amount of field and laboratory data that has accumulated from this area since 1930. In order that the greatest amount of useful information might be obtained, a systematic classification and mapping of the soils of the area was necessary.

The Dominion Experimental Farms Service in co-operation with the Quebec Department of Agriculture began a soil survey of this area in Stanstead county in 1938. In 1939 and 1940 the survey was extended to include the counties of Sherbrooke, Richmond and Compton, covering in all an area of approximately 2,200 square miles or 1,410,210 acres.

This report is a description of the soils, the factors governing their formation and their influence on the agriculture of the four counties. A map showing the areal distribution of the soil types and their relationship to one another is attached to the report. Each soil type is shown in colour and suitable symbols defining the type and its texture are attached.

It should be pointed out that the soil map is the result of a reconnaissance survey and, while it shows the location and extent of each soil type, it is not detailed enough to show the small variations on any individual farm. Hence it should not be used as a strict guide in the purchase of small parcels of land. It may, however, be used as a guide to the utilization of land over fairly wide areas.

In the first part of this report a general description of the area, including its location, history, climate, geology, vegetation and physiographic features is given. These are the factors which affect the formation and development of the soils and their agricultural use. In the latter part of the report, each soil type is described in detail together with its variations, its drainage and capabilities for use. Finally, the management of the soils, their fertilizer requirements, suitability for crops and general distribution is discussed.

The increased importance attached to soil erosion as a destructive factor in crop production and soil management deserves some recognition in this area, where high rainfall and steep slopes facilitate the erosion of valuable top soil. Fortunately, soil erosion has not reached as serious proportions as in some other parts of Canada. In a survey of this kind it is possible to observe and record instances of such destructive action and to note the types of soil and topography which are most subject to erosion. The effect of slope, land use and the type of soil on erosion is discussed in a general way.

The results of experimental work on soils and crops carried on in the area are discussed in relation to the various soil types. This will enable the farmer

to know more about the capabilities of the soils on his farm and bring him in touch with the experiences of other farmers on similar or different soil types. The agriculture of the area has improved considerably in the past two decades and a survey of this kind serves to point out the possibilities for further development along some lines and the necessity for retrenchment along others.

Description of the Area

Location and Extent of the Area

The four counties of Stanstead, Sherbrooke, Richmond and Compton described in this report comprise part of the area known as the Eastern Townships of Quebec. The exact location of the surveyed area may be seen from the accompanying sketch map (Fig. 1). It extends from Megantic mountain on the east to Lake Memphremagog on the west and from the International Boundary on the south to Shipton Pinnacle on the north and includes an area of about 2,200 sq. miles or 1,410,210 acres. This area is distributed as shown below.

County	Area
Stanstead	288,820 acres
Sherbrooke	150,220 "
Richmond	341,020 "
Compton	630,150 "
Total	1,410,210 "

Each county consists of a number of townships, originally intended to be ten miles square, but owing to difficulties in the early days of settlement, several of the townships were split up and lost their intended shape. Stanstead county, bordering on Lake Memphremagog, and composed of the townships of Magog, Hatley, Stanstead, Barford and Barnston, is the southwestern county of the area. Sherbrooke county, composed of the townships of Orford and Ascot, is the smallest county and lies directly north of Stanstead county. Richmond county comprises the townships of Brompton, Melbourne, Cleveland, Stoke and Windsor and lies north of Sherbrooke county. Compton is the largest county and comprises the townships of Compton, Clifton, Hereford, Eaton, Westbury, Bury, Auckland, Ditton, Newport, Hampden and Lingwick. It lies east of the counties of Stanstead, Sherbrooke and Richmond which form its western boundary. The whole area lies in that part of the province known as the Appalachian upland. The northern tip of the area is about 70 to 80 miles south of the St. Lawrence River, and Sherbrooke, the approximate centre of the area, is about 100 miles east of Montreal.

Population

The total population of the four counties as recorded by the Census of 1931 was 109,377 persons, of whom 32·9 per cent or 35,996 were on farms. The distribution of the population is shown in table I, below.

TABLE I

County	Population			Number on farms	
	1911	1921	1931	1931	per cent
Stanstead	20,765	23,380	25,118	8,595	34·2
Sherbrooke	23,211	30,786	37,386	4,598	12·3
Richmond	21,282	24,067	24,956	10,428	41·7
Compton	21,235	23,271	21,917	12,375	56·4
Total	86,493	101,504	109,377	35,996	32·9

The increase in population in Sherbrooke county shown in 1921 and again in 1931 is due to the increase in industrial activity rather than to the increase in farming population. Many factories were erected during this period and the prospects of shorter hours and better pay drew many people from the farms to the city.

The French are the dominant racial class, as shown in table II, but several other racial classes are represented. Both English and French languages are spoken, but the farm population is more or less segregated into English and French speaking sections.

TABLE II

County	French	British	All others
Stanstead	16,622	8,197	299
Sherbrooke	26,842	9,810	734
Richmond	19,613	5,128	215
Compton	14,683	6,847	387
Total	77,760	29,982	1,635

History and Development of Agriculture

Only a brief outline of the general agricultural development of the area will be given here. The agricultural practices and their relation to the soils of the area are discussed in another part of this bulletin.

Until the year 1791 the area known as the Eastern Townships was a vast, forested wilderness. Travel through the area was along Indian trails and by canoe or boat along the rivers of the country. The first vehicles were introduced about 1807 and oxen were first used for drawing them, since the roads were scarcely passable at that time.

Toward the close of the eighteenth century and particularly between the years 1800 and 1810, this area was the scene of great activity. Land was cleared, sawmills erected and homes established. The first settlers were chiefly United Empire Loyalists, soldiers of the Canadian militia and English, Irish, Scottish and American immigrants who were attracted by the cheap and fertile land north of the border. The system of tenure differed from that of French Canada. The area of a township was granted to a number of individuals who organized themselves into a company of "associates". An agent was elected from among them whose duty it was to transact all business of the township with the government. This agent had to agree to bear the expense of surveying the area, open a road through it, erect mills and to obtain the signatures of forty individuals signifying their intention of becoming settlers. The earliest known settlers seem to have established themselves about the year 1774.

In 1833, the British American Land Company, capitalized at more than one and one-half millions of dollars, bought large tracts of land in this area and proceeded to settle it with immigrants from the Old Country. This company did much toward opening up the country, building mills, erecting schools and churches and constructing roads. The virgin forests were cut down and for many years the profits of the forests were the sole source of income for many of the settlers and much of the wood was burned for potash and shipped down the St. Francis River to Three Rivers and Quebec. This was so profitable that considerable wholesale destruction of valuable timber occurred.

The chief agricultural occupation is dairy farming with its production of butter and cheese, but the production of honey, maple sugar and syrup, forest products, grain and hay also hold an important place in the agriculture of the

TABLE III.—LAND UTILIZATION IN THE SURVEYED AREA

County	Total land area (acres)	Acres occupied land	% of total occupied	No. of farms	Average acres per farm	Improved Cleared Land		Unimproved Occupied Land				Difference in woods or rough land
						Total	Average per farm	Natural pasture	Wooded	Swamp	Total	
Stanstead	288,820	241,448	83·6	1,769	136	87,652	49·5	89,430	59,353	5,013	153,796	47,372
Sherbrooke	150,220	91,603	60·9	877	104	39,652	45·2	21,826	27,796	2,329	51,951	58,617
Richmond	341,020	247,476	72·5	1,967	126	114,890	58·4	68,067	61,334	3,185	132,586	93,544
Compton	630,150	387,050	61·4	2,470	156	121,233	49·0	117,475	143,029	5,313	265,817	243,100
	1,410,210	967,577	68·6	7,083	136	363,427	51·3	296,798	291,512	15,840	604,150	442,633

*Compiled from Statistical Year Book—Quebec, 1934.

area. In table III the utilization of the land in the surveyed counties is shown. It is evident that Stanstead and Richmond are more densely settled than the counties of Sherbrooke and Compton. This is due in part to the larger areas of rough, uncultivable land in these latter two counties. The percentage of cleared land per farm is highest in Richmond county, where many farms lie along the fertile river valleys and are easily cleared. Many farms in the rougher areas have been abandoned in recent years. In general about 37·5 per cent of the land on each farm is cleared and under cultivation. Of this cleared land, about 50 to 60 per cent is in hay, the remainder being in cultivated crops. The unimproved land usually consists of natural pasture and woodlot.

Table IV shows the acreage and distribution of crops in the surveyed area, both in 1931 and 1940. The general trend of crop production has been to decrease the acreage in hay and to grow more corn for silage, and roots. Some of the hay land has run out or has been allowed to revert to pasture or go back into woods. Particularly striking is the increased acreage of oats in all counties and the increase of barley in Stanstead and Richmond. Potato raising seems to be on the increase in all counties except Stanstead, which shows a stronger tendency toward dairying and the consequent raising of silage crops.

TABLE IV.—*ACREAGE AND DISTRIBUTION OF CROPS IN THE SURVEYED AREA

County	Wheat	Oats	Barley	Fodder corn	Hay and clover	Potatoes	Roots	Small Fruits
Stanstead—								
1931	81	9,670	743	692	62,695	1,297	591	27
1940	70	11,060	1,680	1,130	50,270	1,040	830	....
Sherbrooke—								
1931	73	4,646	193	147	24,034	778	312	26
1940	230	5,760	80	290	20,830	850	240	....
Richmond—								
1931	100	14,113	857	320	66,619	1,363	483	5
1940	20	19,090	1,870	250	58,970	1,530	660	....
Compton—								
1931	77	13,892	1,278	252	77,739	1,649	867	23
1940	230	15,140	920	610	73,190	2,380	930	....
Total—								
1931	331	42,321	3,071	1,411	231,087	5,087	2,253	81
1940	550	51,050	4,550	2,280	203,260	5,800	2,660	....

*1931 figures from Quebec Statistical Year Book—1934.
1940 figures from Final Crop Report—Dept. of Trade and Commerce, Quebec—1940.

The dairy industry is well developed in this part of the Townships and many fine herds of cattle are found here. The chief dairy breeds are the Jersey and Holstein, with occasional herds of Guernsey and Ayrshire cattle while in Compton county some Hereford herds are kept for beef. Good pasturage is becoming a problem in many districts and much improvement has been made in recent years through the use of fertilizers and rotational grazing. The manufacture of butter and cheese is an important industry in all the counties and considerable amounts of other dairy products such as ice-cream and evaporated milk are also produced. In table V, the amount of butter and cheese manufactured in the four counties in 1928 and 1938 is compared. It is evident that radical changes have taken place in the production of dairy products over the ten-year period. Compton county has greatly increased its butter production. This has been due to the rapid clearing of land and to the tariff on cream shipped to the United States, which formerly provided a good source of revenue to many farmers. A natural increase has also resulted from the increased number of dairy

cattle being kept. The increase in butter production in Sherbrooke county has been due in part to the attractive market for milk provided by the large dairies in the city of Sherbrooke. Due to falling prices, the manufacture of cheese has been considerably reduced, but war-time requirements have bolstered cheese production.

TABLE V.—PRODUCTION OF BUTTER AND CHEESE IN THE SURVEYED AREA*

County	Number of butter and cheese factories				Pounds products made		Dollars value	
	Total	Butter	Cheese	Both	Butter	Cheese	Butter	Cheese
Stanstead—								
1928	3	3	....	....	434,834	....	165,207	....
1938	8	7	....	1	2,138,453	....	547,257	....
Sherbrooke—								
1928	4	3	1	....	137,135	....	54,103	24,987
1938	5	4	....	1	1,006,834	....	245,940	....
Richmond—								
1928	25	7	17	1	528,277	1,099,607	200,250	225,278
1938	21	7	11	3	795,803	639,074	210,456	84,768
Compton—								
1928	6	3	1	2	48,747	27,088	18,057	5,758
1938	17	16	1	....	2,455,257	45,590	596,822	6,155

* From Quebec Statistical Year Book, 1929 and 1939.

Many factors operate to bring about the changes indicated above. The clearing of land, changes in the type of farming, feed prices, soil fertility and the demand for dairy products are a few of these factors. Cheese prices have been falling steadily and this has tended to divert more milk into butter. The manufacture of ice-cream has been on the increase and has helped to take up the slump caused by low cheese prices.

An important source of income of the four counties is the revenue from forest products. The amount and value of forest products in 1931 is given in table VI below.

TABLE VI.—AMOUNT AND VALUE OF FOREST PRODUCTS, 1931

County	Pulpwood	Firewood	Lumber	Value
	(cords)	(cords)	(ft.)	$
Stanstead	3,717	46,413	959,000	264,677
Sherbrooke	609	19,109	329,000	117,448
Richmond	1,988	53,500	890,000	257,793
Compton	11,906	70,379	6,691,000	468,696
Total	18,220	189,401	8,869,000	1,108,614

The greater part of the forest revenue comes from Compton county and the figures given above have greatly increased during recent years due to the activity of the pulp and paper industry, expansion in the building trades and the demand for ships and building materials for war purposes.

Transportation and Markets

Adequate means for transporting farm products to markets are essential to a successful and progressive agriculture. The four counties under discussion are well supplied with roads and railways connecting the more densely populated areas with the farming districts and a glance at the map shows that the city of Sherbrooke is a centre from which roads lead in all directions through

the four counties. This is natural, since Sherbrooke is, by far, the largest centre of population and affords an excellent market for the district.

The No. 1 provincial highway connects Sherbrooke with Montreal and Quebec by a hard-surfaced road. It also passes through the towns of Magog, Ascot Corners and East Angus. A second good gravel road, No. 28, also runs to Quebec and passes through Lennoxville, Birchton, Cookshire, Bury and Gould, all of which are active farming centres. Sherbrooke is also connected with the State of Vermont to the south by two highways. The first (No. 5) is hard surfaced and runs southward through Stanstead county, passing the towns of Waterville, North Hatley, Stanstead and Rock Island. The second (No. 22) is a gravel road and runs through the Coaticook valley, passing Compton, Coaticook, Dixville and Stanhope. North of Sherbrooke this highway is paved and runs through Richmond to Drummondville. The No. 27 highway running south from Cookshire to Beecher Falls, Vt., forms an outlet for the towns of Sawyerville, St. Edwidge and Hereford in the eastern section of the area. Several intermediate roads connect the smaller villages with the larger towns.

The town of Ayer's Cliff is connected to the No. 1 highway by route 50, which also runs eastward across Stanstead county through Barnston. Most of the secondary roads are in excellent condition, but in the southeastern part of the area many of the roads tend to wash out during the heavy rains which often occur during the summer months.

Several railway lines run through the area. The Quebec Central Railway connects with the Boston and Maine Railway at Beebe on the International Border and runs along the Tomifobia valley to Sherbrooke and thence northward through Ascot Corners and East Angus to Quebec. The Canadian National Railway runs through the Coaticook valley to Sherbrooke and thence through Richmond to Montreal and Quebec. The Canadian Pacific Railway from Montreal crosses the area from west to east, passing through Magog, Sherbrooke, Lennoxville, Cookshire, Bury, Gould and Scotstown. It also maintains a branch line from Eastman through Richmond county to connect with the C.N.R. at Windsor.

With such facilities as these there is no difficulty in getting farm products to market. In the eastern section of the area the transportation facilities are not so well developed and many farms are quite a distance from rail points or even good roads. This section is still dependent for a large amount of its revenue on products of the forest.

The city of Sherbrooke furnishes the largest market for farm products. In 1938, besides butter and other dairy products, some 86,000 gallons of ice-cream were produced there. There are several large dairies in the city and a plant for manufacturing evaporated milk. Magog and Coaticook in Stanstead county and Richmond in Richmond county are the next largest towns and offer good markets for farm products. East Angus, Brompton and Windsor with their pulp and paper factories and large industrial population consume a large quantity of agricultural produce, both from farm and forest. Another large market is provided by the mining town of Asbestos in the north of Richmond county. There are a number of villages throughout the area which, because of their scenic and tourist value, enjoy a marked increase in population during the summer months and this forms an outlet for a large amount of market garden produce. A number of farmers' co-operative organizations are found at different places within the area and these conduct and control the sales of milk, live stock, wool, and other farm products.

Climate

Climate is one of the major factors governing the development of soils from rocks and it also governs to a large extent the crops which can be grown in an area. The climate of the province of Quebec is humid temperate. The

TABLE VII.—TEMPERATURE RECORDED AT VARIOUS STATIONS, 15-YEAR AVERAGE, 1923–37

Month	Lennoxville (500′)			Sherbrooke (700′)			Brome (700′)			East Angus (600′)			Lake Megantic (1,400′)		
	Daily mean	Extreme highest	Extreme lowest	Daily mean	Extreme highest	Extreme lowest	Daily mean	Extreme highest	Extreme lowest	Daily mean	Extreme highest	Extreme lowest	Daily mean	Extreme highest	Extreme lowest
January	14·1	57	−48	15·5	55	−29	15·5	57	−35	12·2	56	−44	13·0	52	−38
February	13·6	53	−43	14·6	53	−31	14·0	51	−37	11·6	53	−40	11·5	64	−38
March	25·2	63	−30	26·1	65	−31	25·0	67	−36	23·2	60	−24	22·0	65	−35
April	39·0	82	3	39·4	81	7	38·1	80	0	38·2	83	− 2	25·1	77	0
May	51·2	89	23	52·5	90	25	51·4	88	22	50·6	90	21	49·2	85	20
June	61·6	93	25	62·9	95	34	61·0	92	31	61·5	93	30	59·0	87	32
July	65·9	96	34	66·6	98	42	68·4	92	36	66·0	95	38	63·4	90	32
August	64·4	97	30	64·5	94	37	62·5	92	33	63·5	94	36	62·0	92	37
September	56·7	93	16	57·2	90	28	56·7	88	21	55·5	89	26	54·5	84	15
October	45·2	85	13	44·8	82	18	44·7	78	11	44·7	85	13	42·2	79	10
November	33·5	70	−16	39·1	75	− 8	33·2	68	−13	33·5	71	−13	30·5	70	−10
December	17·1	57	−48	18·5	63	−39	17·5	65	−38	16·2	62	−44	15·4	60	−40
Annual	40·6	....	....	41·8	....	....	40·6	....	....	39·7	....	....	37·3	....	....

Data compiled from statistics of the Meteorological Division, Department of Transport, Canada.

relatively heavy rainfall and the variation in daily temperatures are factors which promote a high degree of weathering or breaking down of rock materials.

In order to obtain a broad picture of climatic conditions within the area, the rainfall and temperature data from five stations either in or adjacent to the area were selected. Lennoxville, Sherbrooke and East Angus are in the central section of the area. Megantic is just outside the area on the east and Brome about 15 miles to the west of the area. The variations in temperature at the five stations are recorded in table VII.

The lowest winter temperatures are recorded at Lennoxville and the highest summer temperatures at Sherbrooke and Lennoxville. Sherbrooke and Lennoxville usually have the first warm weather in the spring, followed in turn by Brome, East Angus and Lake Megantic. The influence of bodies of water at Brome and Lake Megantic tends to modify the temperatures at these stations, while Lennoxville, Sherbrooke and East Angus are in the St. Francis River valley and not so much influenced by large bodies of water. In general, temperature decreases from west to east in the area, although the mean daily temperatures are about the same at all stations.

From data recorded at Sawyerville, in the eastern section of the counties, it would seem that the soil temperature at a depth of two feet rises steadily from May (45°-47° F), reaching a maximum of 60°-65° F. about the end of August. It declines to its May value about the end of October. This would mean that evaporation of moisture from the soil would reach a maximum about the end of August.

The data for precipitation at the five stations are presented in table VIII. It may be seen that Brome has the greatest total precipitation, followed by Lennoxville, East Angus, Lake Megantic and Sherbrooke. This emphasizes the great local variation in rainfall, since Sherbrooke is only four miles from the Lennoxville station. More significant figures are obtained by comparing the percentage of rainfall which falls during the growing season. In this case it appears that Brome receives 20·85 inches or 47·3 per cent; Sherbrooke receives 17·14 inches or 45·4 per cent; Lake Megantic receives 17·37 inches

TABLE VIII.—MEAN MONTHLY PRECIPITATION AT FIVE STATIONS—15-YEAR AVERAGE (1923–37)

Month	Lennoxville	Sherbrooke	Brome	East Angus	Lake Megantic
January	3·83	3·56	4·21	3·01	3·95
February	2·64	2·36	2·77	2·20	2·49
March	3·06	2·53	3·43	2·54	2·84
April	2·88	2·63	3·76	3·08	2·55
May	3·29	2·90	3·79	1·63	3·65
June	3·46	3·28	4·32	4·76	3·79
July	4·22	3·91	4·72	3·08	3·33
August	3·53	3·36	3·31	2·09	3·07
September	3·50	3·69	4·71	4·71	3·50
October	3·30	3·10	3·94	2·47	3·29
November	3·73	3·47	4·00	6·18	3·25
December	3·19	2·91	3·11	3·36	2·98
Mean annual precipitation	40·63	37·70	44·07	39·11	38·69
Mean precipitation for growing season	18·00	17·14	20·85	16·26	17·37

Data compiled from statistics of the Meteorological Division, Department of Transport, Canada.

or 44·9 per cent; Lennoxville receives 18·00 inches or 44·3 per cent, and East Angus receives 16·26 inches or 41·6 per cent of its total rainfall during the months from May to September. Sawyerville reports 20 inches of rain during

the same period. This means that nearly half of the annual precipitation falls during the growing season and this is usually heaviest during the latter part of June and throughout July. While this may be beneficial to crops, it also causes heavy leaching of the soil as well as considerable erosion. In some seasons there is excessive rainfall during the summer. In 1924, Brome recorded 9·03 inches of rain in September and 6·03 inches in July of the same year, while Lennoxville recorded over 8 inches of rain in July, 1931 and 1938, but in general, the precipitation is quite evenly distributed throughout the year.

The average length of the frost-free growing season is shown in table IX. The length of this frost-free period restricts the production of certain crops in this area. The longest average frost-free season is recorded at Sherbrooke, followed in turn by Lake Megantic, East Angus, Brome and Lennoxville. Sherbrooke may be expected to be the first frost-free district in the spring, but the others are only slightly behind and frost may be expected in the fall about September 3 to 12 in Lennoxville, East Angus and Brome, but a week or two later at the other centres. In any one year there may be very little difference between any of the stations, although Brome and Lennoxville usually have the shorter seasons.

TABLE IX.—LENGTH OF FROST-FREE GROWING SEASON (DAYS)
14-YEAR AVERAGE, 1924–37

Station	Latest frost recorded	Earliest frost recorded	Average dates		Frost-free period		
			Last frost	First frost	Average	Longest	Shortest
Lennoxville	June 6	Aug. 31	May 23	Sept. 11	110	124	89
Sherbrooke*	May 25	Sept. 14	May 17	Sept. 28	134	157	113
Brome	June 16	Sept. 4	May 29	Sept. 17	111	140	90
East Angus	June 28	Sept. 4	May 27	Sept. 17	113	140	78
Lake Megantic	June 4	Sept. 10	May 22	Sept. 23	124	148	101

*1928–1937 only.
Data compiled from statistics of the Meteorological Division, Department of Transport. Canada.

The number of hours of sunshine recorded at Lennoxville is given below. No data are available for the other centres, except Sherbrooke, which averages about 200 hours more sunshine than Lennoxville. One reason for this is the fact that the sun is obscured from the Lennoxville station by the heavy mists, which often fill the St. Francis valley during the better part of the mornings in September and October and in the early spring, but is enjoyed by the Sherbrooke station at higher elevation.

HOURS OF SUNSHINE—LENNOXVILLE (15-YEAR AVERAGE)

January	73·4
February	95·4
March	130·0
April	155·0
May	201·0
June	216·0
July	240.0
August	221·0
September	154·0
October	125·0
November	61·0
December	57·0
Total	1,728·8

During the summer, hot days are frequent and during the winter low temperatures are common, together with considerable snow. Rainfall is heavy, particularly during the growing season and occasionally some crop damage results. It is interesting to note that the greatest precipitation takes place during

the months which have the most sunshine. This is explained by the fact that much of the rain falls at night.

There are many local variations in rainfall and consequently local differences in the amount of leaching. The land at higher elevations usually has sufficient slope to ensure good drainage and the soils are ordinarily well drained. At the lower elevations the soils receive drainage from the higher slopes and, if they have not sufficient slope or adequate structure to permit easy drainage, they tend to become wet and cold. In these cold soils microbiological activity is at a minimum, the soil processes slowed down, aeration is poor and crop production is hindered. On the other hand, the more open types of soils such as the sands and gravelly soils may have excessive drainage and be too dry to support a crop. In this case heavy rainfall may be of benefit in supplying enough moisture to carry a crop through the summer months.

The effect of prevailing winds has some bearing on the rainfall and evaporation within the area and consequently on soil development. From November to April or May, the prevailing wind at Sherbrooke is from the north and northwest but during the summer months the wind blows from the south and southwest quarter. Snowfall is usually heaviest in Brome and Lake Megantic and these centres have a late spring.

Vegetation

The effect of vegetation on soil formation is nearly as important as that of climate. Several factors determine the vegetation of any area. Among these may be listed temperature, altitude, slope, degree of shade, precipitation and the temperature, moisture, drainage, aeration and fertility of the soil. Throughout the whole area deciduous forest, consisting of maple, beech, grey birch and some elm is generally found on the higher slopes. The lower slopes have a more mixed vegetation consisting of maple, old field birch, balsam fir and occasional pine, while in the poorly-drained areas hemlock, cedar, black spruce, tamarack, alder and willow are the dominant vegetation.

The pasture flora varies considerably and depends on the treatment which it has received. As has been pointed out by Whyte (19) it is a "man conditioned climax". Many pastures have been allowed to grow back into bush and are covered with small white birch and poplar. Spiræa (*Spiræa tomentosa*), commonly known as hardhack, is common in most parts of the area, particularly in Stanstead and Sherbrooke counties. The most frequently occurring grasses are red top (*Agrostis alba*), red fescue (*Festuca rubra*), Kentucky blue grass (*Poa pratensis*), and poverty grass (*Danthonia spicata*). Other prominent grasses include Canada blue grass (*Poa compressa*), timothy (*Phleum pratense*), couch grass (*Agropyron repens*), creeping bent grass (*Agrostis stolonifera*), manna grass (*Glyceria striata*), and sweet vernal grass (*Anthoxanthum odoratum*). These last-mentioned grasses occur almost universally but not in great quantities. Brown top (*Agrostis tenuis*) seems to be abundant in pastures in the eastern section of the area, but not elsewhere.

Many of the legumes are seen in the better pastures and the most frequent occurring is white clover (*Trifolium repens*). Other species consist of red clover (*Trifolium pratense*) and hop clover (*Trifolium agraricum*). The pastures also support a large weed flora commonly consisting of orange hawkweed (*Hieracium aurantiacum*), yarrow (*Achillea Millefolium*), ox-eye daisy (*Chrysanthemum leucanthemum*), Virginia strawberry (*Fragaria virginiana*), mouse ear chickweed (*Cerastium vulgatum*), sheep sorrel (*Rumex acetosella*), buttercup (*Ranunculus acris*), sedges (*Carex*), rushes (*Juncus*), heal all (*Prunella vulgaris*), Canada thistle (*Cirsium arvense*), and common plantain (*Plantago major*). A variety of berries such as raspberry, blackberries and blueberries are also found in some pastures. The development of the better types of pasture grasses and pasture management is discussed in the latter part of this bulletin.

Physiography

Topography.—The outstanding feature of the topography of this area consists of three fairly parallel ridges running across the area from southwest to northeast, about 25 miles apart. These ridges are anticlines formed during the Appalachian uplift. The most prominent ridge is that on the west of the area known as the Sutton mountain range. It is an extension of the Green Mountains of Vermont and contains many high peaks, the most prominent of which is Mount Orford, with an elevation of 2,800 feet. This ridge enters the area in the northwest corner of Stanstead county and continues through the western part of Richmond county.

The second ridge is more modified and is known as the Sherbrooke or Stoke ridge. It rises in the southwestern part of Stanstead county as Bunker Hill, runs northeasterly through Sherbrooke county as Massawippi mountain and continues to form the eastern boundary of Richmond county where it is known as Stoke mountain. The St. Francis River cuts across this ridge at Sherbrooke.

The third ridge on the extreme eastern boundary of the area is not well defined, but is formed chiefly by Megantic mountain, which has an elevation of 3,500 feet above sea level. Between these ridges the topography varies from nearly level valley floors to rolling hills. All rivers, except the St. Francis, run parallel to the principal ridges. Elevations within the area vary from 523 feet on the shore of Lake Massawippi to 3,500 feet on the top of Megantic mountain. In general, the land slopes from the south and southeast to the north and northeast. The southeast portion of the counties along the International Boundary is very rough and very little of it is suitable for agriculture. Moving from south to north within the area, the trend is from rough, steep slopes to smooth rolling hills and finally to gently undulating and level topography, broken only by the ridges mentioned above, which cut diagonally across the area. The numerous rivers and lakes scattered through the area give it a highly dissected appearance. Most of the lakes are centres of recreation and form a source of revenue to the residents of the area.

Drainage.—The mountains on the south and east of the area, along the International Boundary, form the chief watershed and most of the streams flow in a northerly direction and finally empty into the St. Lawrence River. The largest river is the St. Francis and most of the rivers mentioned below are its tributaries, flowing into it before it leaves the area. The St. Francis rises in Lake Aylmer to the northeast of the area and flows southward and then northward, taking a U-shaped course and cutting across the old Pre-Cambrian ridges at Sherbrooke and Richmond. One of its tributaries, the Tomifobia, rises near Barnston Hill in Stanstead township and flows west and north through Stanstead and Hatley townships into Lake Massawippi. Leaving Lake Massawippi at its northern end, it becomes the Massawippi River and flows northeasterly to join the St. Francis at Lennoxville. The Tomifobia is joined near Ayer's Cliff by the Niger, which rises near the source of the Tomifobia and flows northwesterly through Barnston and Stanstead townships. The Coaticook rises in the State of Vermont and flows north and west through Barford, Barnston and Compton townships to join the Massawippi below Lennoxville. The Moe and Salmon rivers rise within a few miles of each other in Barford township. The Moe flows northwesterly through Barford, Clifton and Compton townships and the Salmon also flows northwesterly through Clifton and Compton townships to join the Moe at Milby, whence it flows into the Massawippi near Lennoxville. Thus the St. Francis has six rivers entering it as one river, the Massawippi, at Lennoxville. This represents a drainage basin of approximately 770 square miles.

The Eaton rises in Auckland township and flows northwesterly through Sawyerville, where it is joined by the Clifton from the south, to enter the St. Francis at East Angus. A second Salmon River is found in Ditton township, where it

rises near Chartierville as Ditton Brook and flows northward to join the St. Francis near its source below Lake Weedon. The Eaton and Salmon rivers drain an area of about 60 square miles. Although the Nicolet rises only a few miles from the St. Francis, it flows about 80 miles northward into the St. Lawrence, passing through the northern tip of the surveyed area. The Stoke rises in the Stoke mountains and flows westward, joining the Watopeka before it enters the St. Francis at Windsor.

Only two principal rivers enter the St. Francis from the west. The Magog River flows eastward from Lake Memphremagog into Lake Magog and then eastward to join the St. Francis at Sherbrooke. Salmon Brook rises in Brompton township and flows into the St. Francis below Richmond.

It is evident that the St. Francis receives a large volume of water from its tributaries in this area. Many of these rivers have considerable fall and are suitable for the development of electrical power. In the early days, this distribution of water power made it easy to establish mills and also facilitated the movement of agricultural products by water. To-day many pulp and paper factories as well as other industries obtain their power from the St. Francis. With such a large system of rivers it may be said that the country is adequately drained, but at the same time there is provided a means whereby the soil may be washed away. Very heavy rains are frequent in the southeastern part of the area along the main watershed. The streams fill quickly and often overflow their banks, washing out roads and bridges and carrying away valuable top soil.

Several large lakes in the area tend to modify the climate of certain sections. Among these may be mentioned Lake Memphremagog, Lake Magog, Lake Massawippi, Brompton Lake, Fraser Lake, Bowker Lake, in the western part of the area, Lake Lyster and Wallace Pond along the International Boundary and McGill Lake and Moffat Lake in the eastern part of the area. With so many lakes and rivers the country has considerable scenic value and many prominent summer resorts are located here.

Geology.—Since soils are the result of weathering of rocks, a knowledge of the rock formations underlying an area is of value in interpreting the origin, pedological and agricultural characteristics of the soils which occur there. The Eastern Townships have been the scene of great change and upheaval and it is little wonder that the soils are varied and complex. This region belongs to the Appalachian chain which extends from the southern United States through Canada to Newfoundland and the rocks of these formations are among the oldest known.

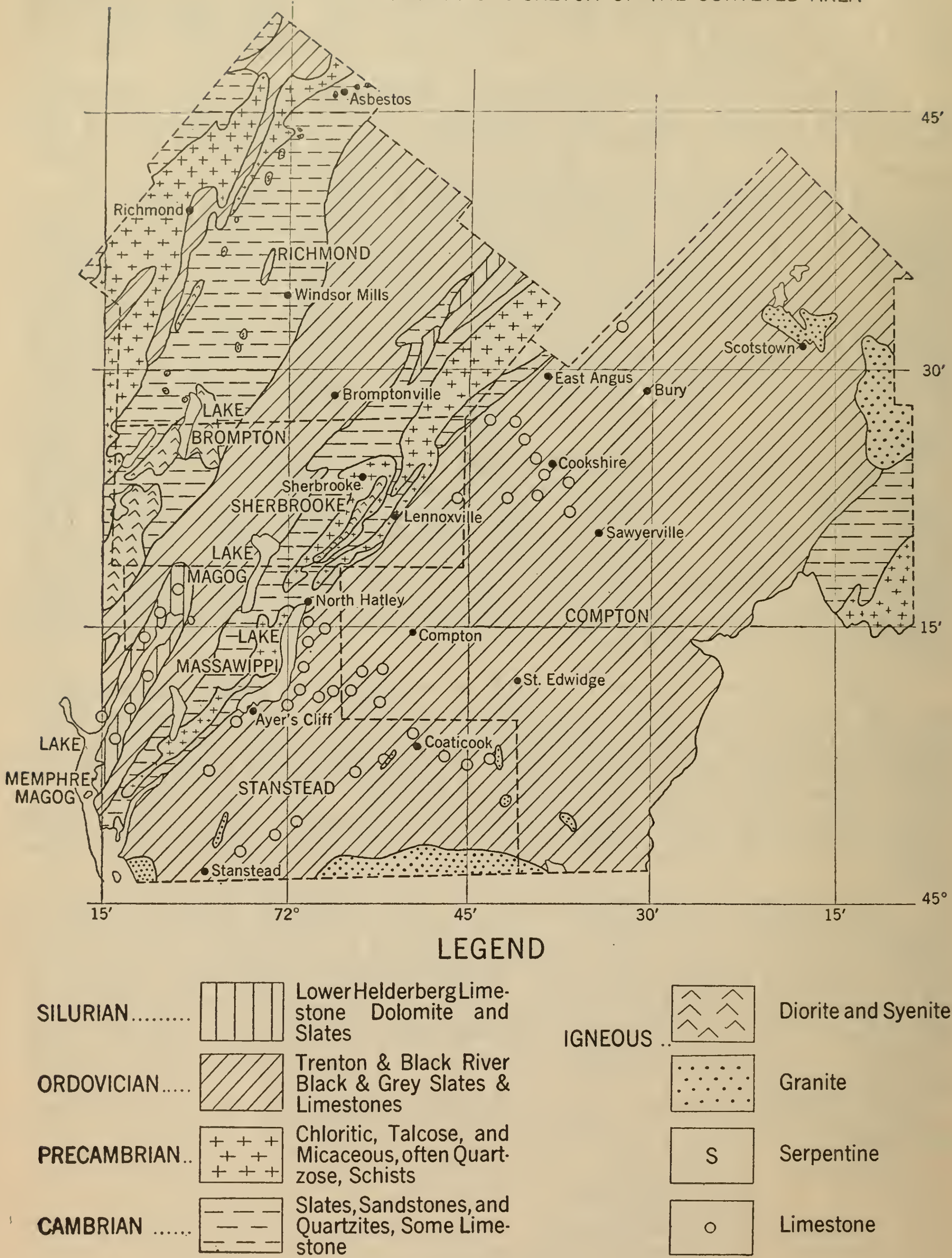
At the close of the Paleozoic age, the rock formations which underlie the area were uplifted and deformed. Long periods of erosion followed and the country was worn down. From evidence obtained by geologists, it appears that several cycles of erosion took place. Finally, the whole area was covered with ice many thousands of feet thick. The mantle of soil was stripped from the hills and all loose materials were transported and reworked by the ice and finally deposited in one form or another to form the soil materials from which present soils have developed.

Five distinct systems of rocks have been recognized in the area and these are classed as follows:—

A. Silurian
B. Ordovician
C. Cambrian
D. Pre-Cambrian
E. Igneous and Crystalline rocks.

The extent and distribution of these systems within the area is shown on the accompanying sketch map. In general, the formations strike from southwest to northeast in the direction of the ridges previously described. The three

GEOLOGICAL SKETCH OF THE SURVEYED AREA



principal ridges are composed of Pre-Cambrian material, flanked on either side by narrow bands of the Cambrian. The country between these ridges is underlain by rocks of the Ordovician system. Several intrusions of granite are found in the Ordovician throughout the area.

The Silurian system of rocks occupies small areas, the largest occurrence enclosing Lake Memphremagog with a narrow band of arenaceous and micaceous limestones about one-half to one mile wide. It is evident from the highly inclined and folded nature of the strata and the intrusion of numerous dykes that they have been subjected to great metamorphic action since their deposition. A second area of Silurian is found near Stoke Centre, where the fossiliferous strata rest on hard schistose conglomerates and blue grey slates. The extension of this formation northward gives rise to the marble quarries at Marbleton and Lime Ridge, just outside the surveyed area.

The Ordovician rocks underlie the greater part of the area, the largest single occurrence lying between the Sherbrooke-Stoke ridge and Megantic mountain. To this system belong the blackish and dark grey limestones, together with considerable thicknesses of black, blue and grey slates and some sandstone. Certain of the blackish and bluish slates are ochre spotted due to the decomposition of a ferruginous dolomite and the rocks are also frequently charged with cubes of iron pyrites. In this area of Ordovician, the slates in the first three miles east of the Sherbrooke-Stoke ridge are largely calcareous, but the remainder are quite free from calcareous material.

A second large area of the Ordovician extends north from Lake Memphremagog, varying in width from five to six miles and lying between the Cambrian rocks on the slopes of the ridges. The formation here consists of different coloured slaty rocks, frequently banded in appearance and the limestones are confined to limited areas. A small, very mixed area occurs near Danville, where black limestones and calcareous slates rest unconformably on the Cambrian rocks. Where granite intrusions occur in the Ordovician, the strata are altered near the point of contact and a somewhat gneissic or schistose structure is imparted to the slates.

The rocks of the Cambrian system lie in narrow bands along the sides of the principal ridges and are composed of slates of various colours, together with sandstones which are often quartzitic, quartziferous schists and conglomerates. The most easterly Cambrian rocks cut across the townships of Ditton and Emberton and are composed of wrinkled black slates and schistose sandstones. Quartz veins are seen at many points and some gold has been taken from these veins. A second area of the Cambrian rocks on the sides of the Sherbrooke-Stoke ridge consists of considerable exposure of conglomerates. On the west side of the ridge, the rocks are composed of the debris of the old ridges in a slaty matrix. On the road between Lake Massawippi and Magog, these rocks rest on greenish chloritic schists. On the east side of the ridge, from Sherbrooke south along Massawippi mountain, lies a thin belt of dark grey or blackish schistose slates which are often wrinkled, resembling the Ditton slates and contain quartz veins from which gold has been extracted.

The third area of the Cambrian may be seen along the slope of the Sutton mountain ridge through western Sherbrooke and Richmond counties. Here, the slates and quartzose beds appear in conformity with the crystalline schists of the Pre-Cambrian. The slates are of various colours and frequently cut by quartz veins. The rocks of this section are irregularly distributed and very mixed.

The distribution of the Pre-Cambrian rocks is confined to the three major ridges already described. The rocks consist chiefly of greenish grey schistose material which is often chloritic and micaceous. The eastern section near the Maine and New Hampshire borders is composed of tough greenish granites, together with chloritic, micaceous and talcose schists and smooth talcose slates.

On the Stoke ridge, the rocks are hard, greenish felspathic schists with some talcose slates. Stoke mountain proper consists of gneissic felsite, falspathic schist and some diorite.

The geology of the third region of Pre-Cambrian, the Sutton mountain anticline, is extremely complicated and has caused much confusion among geologists. In general, the axis of the ridge consists of hard, greenish grey gneissic schists, while the outlying portions on the east and west sides of the ridge are more chloritic in nature and may be associated with black slates.

The igneous rocks occur only in small detached areas and six principal outcrops of granite are found. These are located in Barnston and Barford townships along the International Boundary, Hereford township, near the village of Barnston, Megantic mountain and near Scotstown. It is thought that the granite underlies a considerable portion of the area appearing only when exposed by denudation. Dioritic rocks are seen in several places, usually associated with rocks of the Cambrian system. The largest and most important belt is that which follows the Sutton mountain anticline through western Sherbrooke and Richmond counties. Several serpentinous areas occur in the townships of Melbourne, Cleveland and Shipton and the largest asbestos mine in the world is located in this region.

Such a complexity and variety of rock formation provides the source of many different soil-forming materials and, consequently one would expect the soils in this area to be quite variable in composition and constitution. In the table below a summary of the primary soil materials is given.

Soil Forming Materials

Age	*Composition*	*Where found*
Pre-Cambrian	Hard gneissic felsites, granitic gneiss, felspathic schists, micaceous, chloritic and talcose schists, crystalline schists, some diorite.	Sutton, Sherbrooke and Megantic mountain ridges.
Cambrian	Slates of various colours, sandstones, quartziferous schists, conglomerates, wrinkled slates.	Lower slopes of Sherbrooke, Sutton and Megantic mountain ridges.
Ordovician	Blackish limestones, blackish and bluish slates, sandstones.	Central section between Sherbrooke and Megantic mountain ridges.
	Banded slates of various colours.	Area north of Lake Memphremagog, between Sherbrooke and Sutton ridges.
	Blackish limestones and calcareous slates.	Vicinity of Danville.
Silurian	Arenaceous and micaceous limestones, coarse and fine mica slates.	Vicinity of Lake Memphremagog and Stoke Lake.
Igneous	Granite, diorite.	Scattered areas.

The underlying rock formations are, for the most part, covered with drift of variable depth. This material, distributed by the action of ice and water, forms the structure on which the present soils have developed.

Surface Geology.—The whole of the area has been subjected to glaciation, possibly several times. Antevs (1) believes that it took 25,000 years for the last ice sheet to recede from Hartford, Conn., to north of Cochrane, Ontario. There is some evidence that smaller mountain glaciers had great effect on this area. The surface deposits are very mixed and only a general description will be attempted here.

The deposits may be classified as morainic, glacial outwash, lacustrine and recent alluvial deposits. There are also small areas of reworked glacial deposits. All of the material from which the soils have developed has been moved from its place of origin, but in the case of soils developed on glacial till, it has not been carried very far. That is to say, the till contains a major

proportion of material which is closely associated with the underlying geological formations. The original mantle of debris left by the glaciers has since been sorted by the action of streams and somewhat modified.

Most of the area is covered with glacial till in the form of a ground moraine which varies in depth from a thin veneer to several feet. This till appears to be closely associated in mineral composition with the underlying geological material and in some cases gives the appearance of being residual. It has been leached and weathered and its original texture, colour and composition have been changed to give the present-day soils. The colour of the till varies from a light yellow, through grey to greenish grey and it is often compact. The appearance of the ground moraine reflects its glacial origin. For example, the area near Scotstown is strewn with granite boulders, presumably derived from the Megantic mountain mass to the eastward and the level area near Orford Centre, extending northward several miles, is dotted with small irregular lakes, poorly-drained areas and covered with stony glacial till. On the higher ridges, the bed-rock is frequently exposed and in many places the outcrops are numerous enough to render the land unsuitable for cultivation.

The glacial outwash deposits are scattered along the courses of the principal rivers, particularly along the St. Francis between Sherbrooke and Richmond. At Windsor Mills these deposits form large, conical or ridge-shaped hills having elevations of 50 to 100 feet above the present flood plain. In the vicinity of Danville and also along the main highway south of Lennoxville, the gravel is usually stratified and covered with a few feet of fine and coarse sand containing small quantities of gravel. There are also gravel deposits occurring in the form of kames and eskers in which the gravel is poorly sorted. Gravel deposits are found in many places throughout Stanstead county at an elevation of several hundred feet above the present stream level. Along the Coaticook, St. Francis and several of the smaller rivers, the outwash is deposited on lacustrine clay, which is often many feet deep. The deposits over the clay vary in depth from a thin layer to two or three feet.

The recent alluvial deposits are typified by the flat flood plains along the river courses. Usually these flat areas, which are composed of fine and coarse sand to a depth of several feet, are quite large and suitable for agricultural purposes. Several deposits of lacustrine clay are found throughout the area, one of which is located on the Experimental Station at Lennoxville. This is a deep, heavy clay and is usually poorly drained.

NOTE.—The authors have drawn quite extensively on the reports of the Geological Survey of Canada for their information on the sub-surface geology of the area, supplementing it with their own observations in the field. Recent geological work in this area (unpublished) seems to indicate that most of the formations described above belong to the same age, merely differing in their degree of metamorphism.

Soil Survey Methods and Definitions

Soil surveying consists of the examination, mapping and classification of soils in the field. Each soil type differs in colour, texture and composition from the unweathered parent material from which it has been derived and reflects the climatic and vegetative influences to which it has been subjected. The soils were examined frequently and each horizon or layer of each soil, as well as the parent material, was studied in detail and the differences in texture, colour, structure, drainage, relief and vegetation were noted.

The usual method of mapping was to drive along all the roads in the area, stopping frequently to examine the soils and often to make short traverses at right angles to the roads. In many cases where the roads through a particular section were some distance apart, several traverses on foot were necessary. Notes were taken regarding the relief, drainage and general characteristics of the soils and detailed descriptions of profiles of the same types, were recorded in field note-books. The boundaries between the soil types could be accurately located near the roads, but in heavily wooded areas the lines were drawn from observa-

tions made at several points. The data were recorded on maps of the Topographical Survey having a scale of one inch to one mile. From the data collected in the field, maps were drawn showing the location and extent of each soil type. The relief may be judged from the position of the contours on the map.

The type of survey described in this report is known as a reconnaissance survey. It does not permit of detailed examination or the mapping of very small areas, nor the accurate plotting of soil boundaries in heavily wooded or mountainous country. One soil often changes slowly into another, and, in this case, the boundaries must be drawn with some regard to the agricultural significance of the soil in question. Drainage is one of the most important factors in this case.

After the mapping had been completed, each soil type was carefully sampled by digging a large pit in which the profile was typical of the soil type and taking a sample of each genetic layer or horizon, including the parent material. These samples were placed in glass sealers or moisture-proof containers and taken to the laboratory where they were dried and analysed.

Analytical Methods.—The methods used to analyse the soils, except those noted below, are described in the Association of Official Agricultural Chemists' Method of Analysis. Available phosphorus was determined by the method of Truog, Journal American Society Agronomy, 22, 1931, and available potash by the method of Truog, Journal American Society Agronomy, 26, 1934. The photoelectric colorimeter was used to determine both total and available phosphorus.

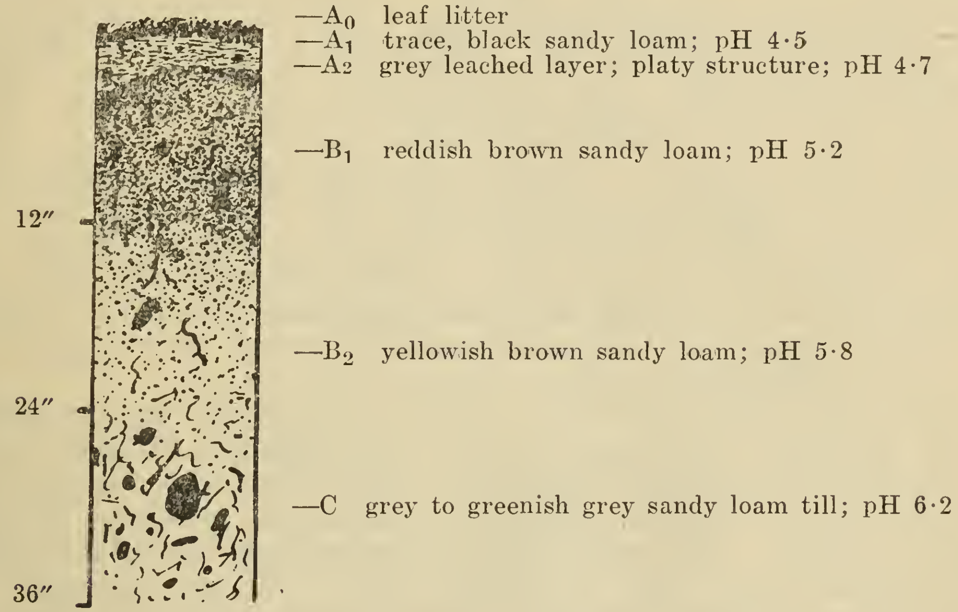
Morphology and Genesis of Soils

The soils described in this report lie in the climatic belt which favours the development of heavily leached soils known as Podsols. The Podsols are developed under conditions of rainfall and evaporation which allow a high percentage of water to percolate through the soil. In some cases, high temperatures and strong winds may have a modifying effect by increasing evaporation and hence causing less leaching, but in the area under discussion, evaporation is usually slow and considerable leaching takes place. The long winters when microbiological activity and leaching are at a minimum are favourable to the accumulation of organic matter on the surface of the soil. During the summer this organic material becomes very acid due to the washing out of soluble bases which are carried downward in the profile. The development of a highly acid, unsaturated complex on the surface and the resulting acid condition of the percolating water, brings the compounds of iron and aluminum into solution. These are washed down farther in the profile often protected by the organic colloidal material and when they reach a zone of lower acidity or other suitable conditions, they are precipitated. This leaching and precipitation process results in the formation of layers or horizons characteristic of Podsol soils. The process of podsolization takes place more quickly in open, light-textured soils than in heavier soils.

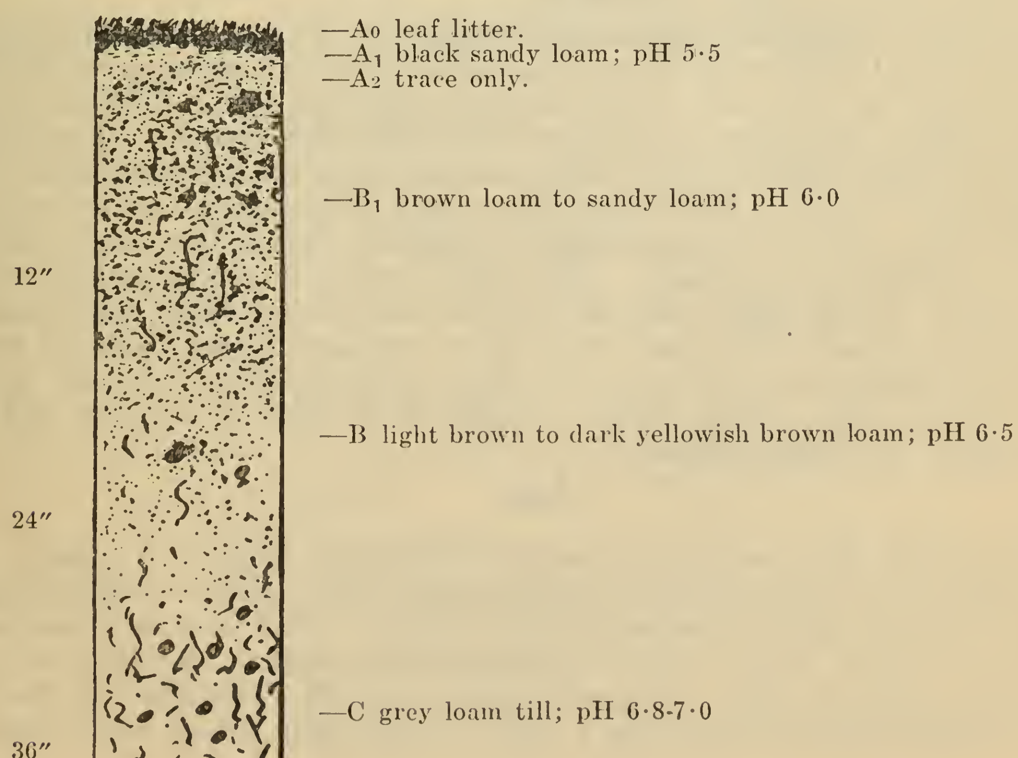
In a well developed Podsol soil there is a greyish white leached layer under the surface mat of organic debris. This is known as the A_2 horizon. Its colour is due to the removal by leaching of the iron and aluminum compounds, leaving a dominance of silica. The B horizon, varying in colour from a brown to a dark reddish brown, is found directly under the A_2 horizon and is a zone of accumulation of the iron and aluminum compounds and the soluble humus complexes. This grades through a yellowish brown colour to the unaltered till or C horizon at a depth of two and one-half to three feet in this region.

Atkinson and McKibbin (2) have shown about 45 to 55 per cent of the acidity of these soils is due to mineral acids and from 9 to 20 per cent of these acids is sulphuric acid. Despite the fact that the bases are readily removed, much of the original mineral material remains and this becomes slowly available as decomposition proceeds. In this way plants are able to succeed on these soils although they are heavily leached. The deposition of bases in the B horizon

has led to the belief that utilization of this layer would be feasible and experiments with deep ploughing have sometimes given good results. A sketch of a typical Podsol soil of this area is shown below.



Accompanying these Podsol soils are small areas which may be classed as Brown Podsolic soils, in which leaching has not been so drastic due to climatic conditions or to the character of the parent material and there is a better supply and distribution of plant nutrients. These soils are found in the extreme western part of the area and are usually at a lower elevation than the Podsols. Most of them show a trace of an A_2 horizon and they are rather a transition type than the true Brown Podsolic soils. The surface consists of a one-half to one-inch layer of organic material, underlain by a brown or dark yellowish brown B horizon which grades into the parent material at a depth of 30 to 36 inches. There are no distinct layers as in the Podsol soils and the transition of the B horizon into the parent material is gradual. The bases are more evenly distributed throughout the profile and these soils are usually better crop soils. A sketch of a typical profile of this area is given below.



The parent materials from which the soils are derived play an important part in their subsequent development and suitability for crops. The permeability of the soil to water and plant roots and its structure depend to a large extent on the character of the parent material. In this area, the principal well-drained soils developed on glacial till are represented by the Becket, Berkshire, Greensboro, Ascot, Sherbrooke and Racine series. The Becket and Berkshire soils are found on the rougher types of topography and are not well suited to agriculture, although much of the Berkshire soils is cultivated. The Greensboro and Sherbrooke soils are found on smooth, rolling land and are developed from slates and limestones. They are good agricultural soils and a large part of the agriculture of the area is carried on where these soils are found. The Ascot and Racine series are also derived from slaty materials, together with some sandstone. Consequently they are light soils and quite heavily leached. They are cultivated to some extent, but the Ascot is usually broken by outcrops and is used extensively for pasture.

The poorly-drained soils developed on till are represented by the Dufferin, Calais, Orford, Brompton and Magog series. The Dufferin and Calais soils are developed from dark-coloured materials and are associated with the Greensboro soils. When drainage is adequate, good hay crops may be grown on these soils, but grain does not thrive. The Orford soils are derived from material containing considerable serpentine and only very small areas are as yet developed. The Magog and Brompton soils are found on level to gently undulating topography and have poor natural drainage. They are quite similar in appearance, being derived from slate and sandstone, but the Brompton soils show more of the sandstone influence. Large areas of these types are cleared and used for hay. grain and pasture.

The soils developed on outwash materials are all well drained, some of them excessively so. They are derived from a variety of materials deposited by the glacial rivers. The Colton and Danby soils are derived chiefly from granitic and gneissic materials and are very well drained. Only the Colton soils are used for farming, while the Danby soils are used chiefly as a source of road gravel. The Shipton and Sheldon soils are developed from outwash materials deposited on lacustrine clay and are not so well drained as the Colton or Danby series, but have a higher moisture-holding capacity which renders them suitable for the production of crops. They are not so acid as the other outwash soils and most of the areas are under cultivation.

The heavier, lacustrine soils are represented by the Coaticook and Lennoxville series. They occur on flat, low-lying topography and are usually good crop soils if drainage is improved. The Coaticook soils are found chiefly along the Coaticook valley and they are subject to considerable erosion. The alluvial soils of the bottom lands are very immature and have no well-developed profile characteristics. They are derived from a variety of materials and consequently are quite fertile, but their susceptibility to flooding makes them only partially useful for agricultural purposes. The Milby series is representative of this class of soils. The organic soils of the area are poorly decomposed and fall into the class of peat. They are made up of raw and fibrous material usually composed of sedges and are found in poorly-drained places underlain by blue clay or compact sand. Rock outcrops appear in all parts of the area and some of the profiles are very shallow.

Soils

The soils of the area were classified into series, types and phases. The series includes all those soils which are developed from similar parent material and show the same genetic horizons in the profile. That is to say, each series would have the same parent material, sequence and colour of horizons, structure, drainage and range in relief. The soil series is usually designated by the name of some geographical unit, such as a town or mountain, which occurs near the

point where the soil is first observed. The type includes those soils within the series whose surface soils are similar in texture. The phase of a soil type is a variation within the type in which some local factor, such as stoniness, relief, drainage or erosion has some practical significance in determining the agricultural value of the soil. The soil type is the principal unit of mapping.

The soils have been differentiated in the scheme outlined below.

Soil Differentiation

A. *Soils developed on glacial till.*

I. *Till derived from impure limestone and slate.*

(*a*) *Well drained.*

1. Greensboro loam.
2. Greensboro shallow loam.
3. Greensboro loam—strongly rolling phase.

(*b*) *Imperfectly drained*

1. Calais loam.

(*c*) *Poorly drained.*

1. Dufferin sandy loam.

II. *Till derived from greenish grey Pre-Cambrian schists.*

(a) *Well drained.*

1. Berkshire loam.

(*b*) *Imperfectly drained.*

a. *slightly podsolized.*

1. Blandford loam.

b. *not podsolized—compact subsoil.*

2. Woodbridge loam.

III. *Till derived from schistose material containing considerable serpentine.*

(*b*) *Imperfectly drained.*

1. Orford sandy loam.

IV. *Till derived from Cambrian slates and sandstones.*

(*a*) *Well drained.*

1. Racine sandy loam.

(*b*) *Imperfectly drained.*

1. Brompton stony loam.
2. Brompton stony gravelly loam.

V. *Till derived from granitic and gneissic materials.*

(*a*) *Well drained.*

1. Becket stony loam.

VI. *Till derived from non-calcareous slates and shales.*

(*a*) *Well drained.*

a. *heavily podsolized.*

1. Ascot sandy loam.
2. Ascot shaly sandy loam.

b. *moderately podsolized.*

1. Sherbrooke sandy loam.
2. Sherbrooke sandy loam heavy subsoil phase.

VI. *Till derived from non-calcareous slates and shales.*—Con.

(*b*) *Imperfectly drained.*

1. Magog stony loam.
2. Magog stony sandy loam.

B. *Soils developed on glacial outwash.*

I. *Soils developed from sandstone and slaty materials.*

(*a*) *Well drained.*

1. St. Francis loamy sand.

II. *Soils developed from granitic and gneissic materials.*

(*a*) *Well drained.*

a. *Occurs on kames and eskers.*

1. Danby gravelly sandy loam.

b. *Occurs on outwash plains.*

1. Colton fine sandy loam.

III. *Soils deposited on lacustrine clay and developed from granitic materials with some impure limestone and slate.*

(*a*) *Well drained.*

a. *heavily podsolized.*

1. Sheldon sandy loam.

b. *moderately podsolized.*

1. Shipton sandy loam.

C. *Lacustrine soils.*

I. *Soils developed from lacustrine silts and clays.*

(*b*) *Imperfectly drained.*

1. Coaticook clay loam.

(*c*) *Poorly drained.*

1. Lennoxville clay loam.

D. *Soils developed on flood plains and river bottoms.*

I. *Soils developed from evenly deposited materials.*

(*a*) *Well drained.*

1. Milby fine sand.

II. *Soils developed from poorly sorted materials.*

(*b*) *Imperfectly drained.*

1. Alluvial soils undifferentiated.

E. *Organic soils.*

I. *Soils developed from organic deposits.*

(*b*) *Poorly decomposed.*

1. Peat.

F. *Miscellaneous soil types.*

1. Rough stony land.
2. Rough stony land—Ascot soil material.
3. Rough stony land—Becket soil material.
4. Rough stony land—Berkshire soil material.
5. Rough stony land—Greensboro soil material.

TABLE X.—ACREAGE AND DISTRIBUTION OF SOIL TYPES

Soil Type	Stanstead		Sherbrooke		Richmond		Compton		Total	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Ascot sandy loam	17,720	6·13	10,390	6·92	33,630	9·86	2,250	0·36	63,990	4·54
Ascot shaly sandy loam	4,050	1·56	....	......	11,420	3·35	....	......	15,470	1·10
Becket stony loam	15,236	5·28	....	......	....	......	1,340	0·22	16,576	1·17
Berkshire loam	21,470	7·43	29,670	19·75	55,500	16·27	580	0·09	107,220	7·60
Blandford loam	....	......	350	0·23	8,540	2·45	330	0·05	9,220	0·65
Brompton stony loam	....	......	2,220	1·46	45,970	13·47	....	......	48,170	3·42
Brompton stony gravelly loam	....	......	....	......	1,440	0·42	....	......	1,440	0·10
Calais loam	27,200	9·42	....	......	....	......	52,860	8·39	80,060	5·68
Colton fine sandy loam	8,110	2·81	3,390	2·26	4,280	1·26	4,910	0·78	20,690	1·47
Coaticook clay loam	5,340	1·85	6,400	4·26	13,310	3·90	15,090	2·39	40,090	2·84
Danby gravelly sandy loam	4,660	1·61	670	0·45	3,900	1·14	9,340	1·48	18,570	1·32
Dufferin sandy loam	35,800	12·40	1,660	1·11	1,260	0·37	59,840	9·50	98,560	6·99
Greensboro loam	51,280	17·76	....	......	....	......	105,020	16·67	156,300	11·08
Greensboro shallow loam	5,030	1·74	....	......	....	......	2,460	0·39	7,490	0·53
Greensboro loam—strongly rolling phase	9,444	3·26	....	......	....	......	178,360	28·30	187,804	13·32
Lennoxville clay loam	....	......	240	0·16	....	......	260	0·04	500	0·04
Magog stony loam	29,670	10·31	31,210	20·78	40,360	11·85	51,640	8·19	152,880	10·84
Magog stony sandy loam	....	......	....	......	....	......	4,290	0·68	4,290	0·30
Milby fine sand	2,830	0·98	3,040	2·02	4,150	1·22	7,780	1·23	17,800	1·26
Orford sandy loam	720	0·25	14,340	9·55	12,560	3·68	....	......	27,620	1·92
Racine sandy loam	....	......	1,730	1·15	28,470	8·40	....	......	30,020	2·16
St. Francis loamy sand	....	......	....	......	7,340	2·15	....	......	7,340	0·52
Sheldon sandy loam	8,640	2·99	13,060	8·69	6,870	2·01	17,290	2·74	45,860	3·25
Sherbrooke sandy loam	....	......	3,040	2·02	....	......	46,670	7·41	49,710	3·53
Sherbrooke sandy loam—heavy subsoil phase	....	......	....	......	....	......	2,220	0·35	2,220	0·16
Shipton sandy loam	....	......	....	......	10,460	3·07	....	......	10,460	0·74
Woodbridge loam	10	0·003	....	......	....	......	100	0·02	110	0·01
Rough stony land—total	12,940	4·48	16,860	11·22	32,850	9·63	35,610	5·65	98·260	6·99
Ascot soil material	....	......	....	......	930	0·27	....	......	930	0·27
Becket soil material	1,760	0·61	....	......	....	......	13,920	2·21	15,680	1·11
Berkshire soil material	7,420	2·57	15,990	10·64	31,600	9·27	3,870	0·61	58,880	4·18
Greensboro soil material	3,450	1·19	....	......	....	......	17,820	2·83	21,370	1·51
Peat	310	0·11	....	......	....	......	....	......	310	0·02
Alluvial soils undifferentiated	2,650	0·92	3,140	2·09	4,640	1·36	4,550	0·72	14,980	1·06
Swampy land	5,520	1·91	2,900	1·93	9,250	2·71	25,090	3·98	42,760	3·03
Lakes	20,190	6·79	5,930	3·95	4,150	1·22	2,340	0·37	32,610	2·31
Fill	....	......	....	......	670	0·23	....	......	670	0·05
Total	288,820	100·0	150,220	100·0	341,020	100·0	630,150	100·0	1,410,210	100·0

The soils are described in detail in the following pages and their acreage and distribution is given in table X.

Soils Developed on Glacial Till

Soils Developed on Till Derived from Slate and Impure Limestone

Greensboro Loam.—The Greensboro loam is the major soil type of the surveyed area. It is found both in Stanstead and Compton counties and, with its shallow loam and the strongly rolling phase, occupies about 25 per cent of the whole area or 351,594 acres. None of this soil type is found in Sherbrooke or Richmond counties. A profile description showing the variation in depth of the horizons is given below.

Horizon	in depth Variation	Description
A_0	0— 1″	leaf litter and matted roots.
A_1	0— ½″	dark chocolate brown to black loam; friable; crumb structure; pH 5·0.
A_2	1— 4″	grey ash-like layer; variable in depth; contains a few small stones; slightly platy structure; pH 5·6.
B_1	3— 6″	dark reddish brown mellow loam; darker in colour under the A_2 and becoming lighter with depth; some stones of slate and quartzite, pH 5·4.

Horizon	Variation in depth	Description
B_2	6—10″	olive coloured loam; friable; contains small particles of black rotted limestone rock, which is of a graphite nature, pH 5·8.
B_3	8—18″	pale olive coloured loam; firm, friable; has black rotted limestone patches, pH 6·4.
C	15—25″	firm to compact grey to greenish grey sandy loam till; contains black rotted limestone and some shale; slightly laminated structure, pH 6·8.

The impure limestone from which the soil is derived is found in small, black fragments throughout the subsoil. It has the appearance of a soft, graphitic schist and is easily crushed between the fingers. Large boulders of the unweathered material will effervesce with acid. Several limestone outcrops occur on the Greensboro loam, the most prominent being at Dufferin Heights, Burroughs Falls, and near Sawyerville. These outcrops consist chiefly of dark slates inter-bedded with slaty limestone. Where this limestone has been ground up in the till it has had some effect on the soil, but the present outcrops have little effect on soil development, since the strata are so highly inclined that the lime is washed down to great depths without affecting the soil. In some small areas near the stream courses the till has been deposited on gravel and these areas are slightly better drained than the normal soil. The native vegetation consists of maple, beech and grey birch, while in the pastures the balsam fir and spiræa are common.

In table XIII in the appendix the chemical and physical analyses of typical Greensboro soils are shown. The organic-matter content as evidenced by the loss on ignition is higher in the surface of the virgin samples, but more evenly distributed throughout the profiles of the cultivated samples. In general, these soils are as well supplied with total phosphorus as the other upland soils of the area, but it is often difficultly available and a large amount of the phosphorus is held in organic form. The amount of potash in these soils compares favourably with that of the other soils of the area. In common with the other soil types of the surveyed area, the Greensboro soils are higher in magnesium than calcium. Their podsolic character is well shown by the concentration of sesqui-oxides, calcium and magnesium in the lower horizons.

The excellent textural nature of these soils is borne out by the physical analyses. They contain enough gravel to keep the soil fairly open and ensure good drainage, yet 80 to 90 per cent of the gravel-free soil is silt and sand in about equal proportions. This imparts a good moisture-holding capacity and at the same time gives satisfactory internal drainage.

Agriculture.—When cultivated, the Greensboro soils have a dark brown surface soil to plough depth and the subsoil becomes a dark yellowish brown loam. The smooth, rolling topography and its good physical condition make the Greensboro loam suitable for a wide variety of crops. In Stanstead county, most of the type is cleared and has been farmed for 50 to 75 years, but in Compton county much of the Greensboro loam is still in forest. This type does not contain enough stone to interfere with cultivation and farm machinery may be used quite readily and, in general, if fertilizer is used and a good seed-bed prepared, all types of crops which mature in the climate of this region may be grown on the Greensboro loam. Hay and grain are the most widely grown crops and the average yield of mixed hay is from 1 to 1½ tons per acre, although some farms have reported as high as 3 tons per acre in a good year. Oats yield from 30 to 40 bushels per acre on the average and some crops of 60 bushels are obtained occasionally. Fodder corn yields an average of 8 to 10 tons per acre;

buckwheat 25 to 30 bushels, wheat 18 to 20 bushels, barley 28 to 30 bushels, roots 8 to 10 tons and potatoes 90 to 100 bushels per acre over a period of years. The growing of alfalfa has not met with great success in this area.

Large areas of the Greensboro loam are in pasture. Unless properly grazed and fertilized, these pastures tend to run out rapidly and become covered with poverty grass (*Danthonia spicata*). The better-grassed pastures are covered with red top (*Agrostis alba*) and Kentucky blue grass (*Poa pratensis*) in Stanstead county, but farther east in Compton country brown top (*Agrostis tenuis*) seems to replace red top. In recent years some effort has been made to improve the pastures by careful grazing and the use of fertilizers. The use of a 0-16-6 applied at the rate of 200 lb. per acre has given good results and further studies are being carried out on this problem. Soil erosion has not become a serious problem on the Greensboro loam, except in small areas where the slopes are quite steep and unprotected by vegetation. Here, the use of close-growing grasses or the planting of trees will do much to check the present washing of the soil.

The *shallow phase* of the Greensboro loam is associated with the normal loam and differs chiefly in its depth and content of the black rotted limestone and slate. It is found chiefly in small areas in Stanstead and Compton counties and has a total area of 7,490 acres. The profile resembles that of the normal loam, but at a depth of 12 to 15 inches it usually rests on the limestone bed-rock. The vegetation is similar to that of the Greensboro loam with maple, beech and grey birch on the well-drained areas and spruce and cedar in the poorly-drained places.

Agriculture.—The cultivated soil is a brown, mellow loam to plough depth and usually has a quantity of shale fragments mixed in it. It occupies somewhat rougher topography than the normal loam and rock outcrops are numerous. Consequently, most of this type when cleared, is used for pasture rather than for cultivated crops and since it is subject to erosion if much cultivation is carried on, pasture is perhaps its most suitable use. Where it is cultivated it has about the same crop value as the normal Greensboro soil, but is probably slightly better for potatoes.

The *strongly rolling phase* of the Greensboro loam is found chiefly in Compton county where it occupies an area of 178,360 acres or 28·3 per cent of the county. There are also about 9,000 acres of this type in Stanstead county. The profile is similar to that of the normal Greensboro loam, but in some places the till is darker than usual and the soil may be more heavily podsolized. The chemical analyses show that the type is quite heavily leached, but is as well supplied with nutrients as the normal loam except in calcium, which is low.

Agriculture.—When it is cultivated, the strongly rolling phase has a surface similar to that of the normal loam and there is little stone to interfere with cultivation. The topography is hilly and the slopes are steeper than in the other Greensboro soils and consequently, this type is more subject to erosion and more care is required in the growing of crops. In some places the surface is broken by numerous outcrops and is unsuitable for farming. Only about 50 per cent of this type is cleared and it is used chiefly for hay and pasture. Hay yields ½ to 1 ton per acre on the average and unless fertilized, is of poor quality, although some good fields yielding 2 tons per acre have been seen. Some millet is also grown on this type. Since most of this type is at a fairly high elevation, usually 1,200 to 2,000 feet, corn does not do well and it is sometimes difficult for oats to mature on the higher slopes. In general, the yields are not so good on this type as on the normal Greensboro loam. Many abandoned farms are to be found and these are growing back into forest.

Calais Loam.—The Calais loam is developed from the same material as the Greensboro soils, but is not so well drained. The greater part of this soil lies in southeastern Stanstead and Compton counties where it occupies an area of

roughly 80,000 acres. A typical profile showing the variations in depth of the horizons is described below.

Horizon	Variation in depth	Description
A_0	0— ½″	dense leaf mat.
A_1	2— 6″	black, friable loam; crumb structure; often mucky when wet, pH 6·0.
B_1	6—10″	dark grey to greenish grey sandy loam; full of angular stones (cobbles), pH 6·7.
B_2	.....	not apparent.
C	15—80″	dark blackish green loam to silty loam; firm, but not compact; slightly mottled; laminated, vesicular structure; contains patches of black rotted limestone, pH 6·8.

The chief characteristic of this soil is its green colour, even after it has been dried. This appears to be due to the crushing of the black graphitic material and its mixture with the lighter-coloured components of the soil. Usually the soil does not show a leached layer.

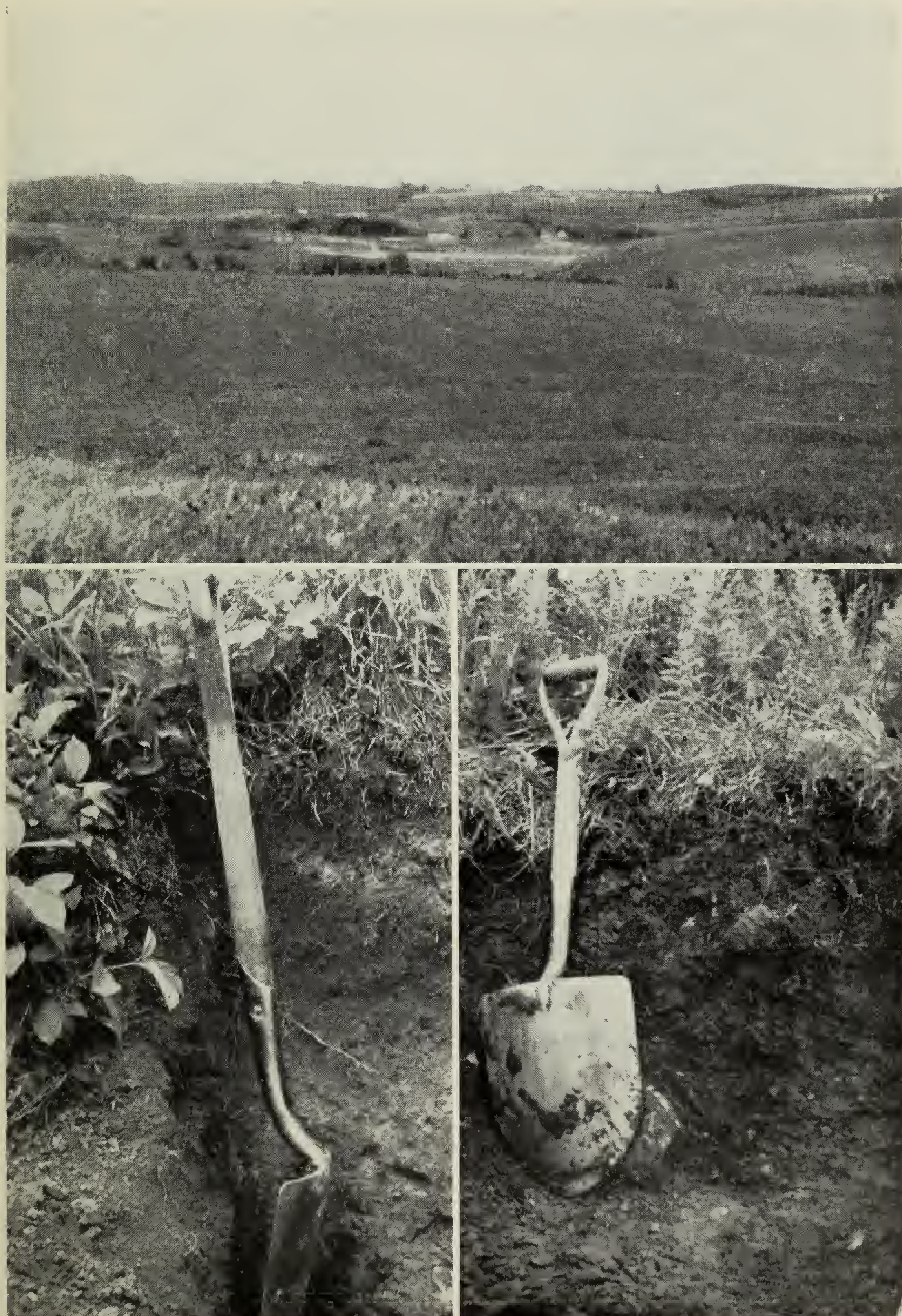
In chemical composition it is quite similar to the Greensboro loam. It contains more phosphorus, both total and available than the Greensboro soils and is not so heavily leached.

Agriculture.—When cultivated the surface soil is a black loam to plough depth. The type occurs on the long slopes of the high hills usually above an elevation of 1,300 feet and has a general slope of about five degrees. The vegetation consists of maple, beech, and spruce. The surface drainage is sufficient to carry off the excess water, but the water percolates very slowly through the soil. Consequently, it is not a well-drained soil, but it is sufficiently drained to allow cultivation, except in some small depressed areas. Considerable moisture is held in the surface soil which is high in organic matter.

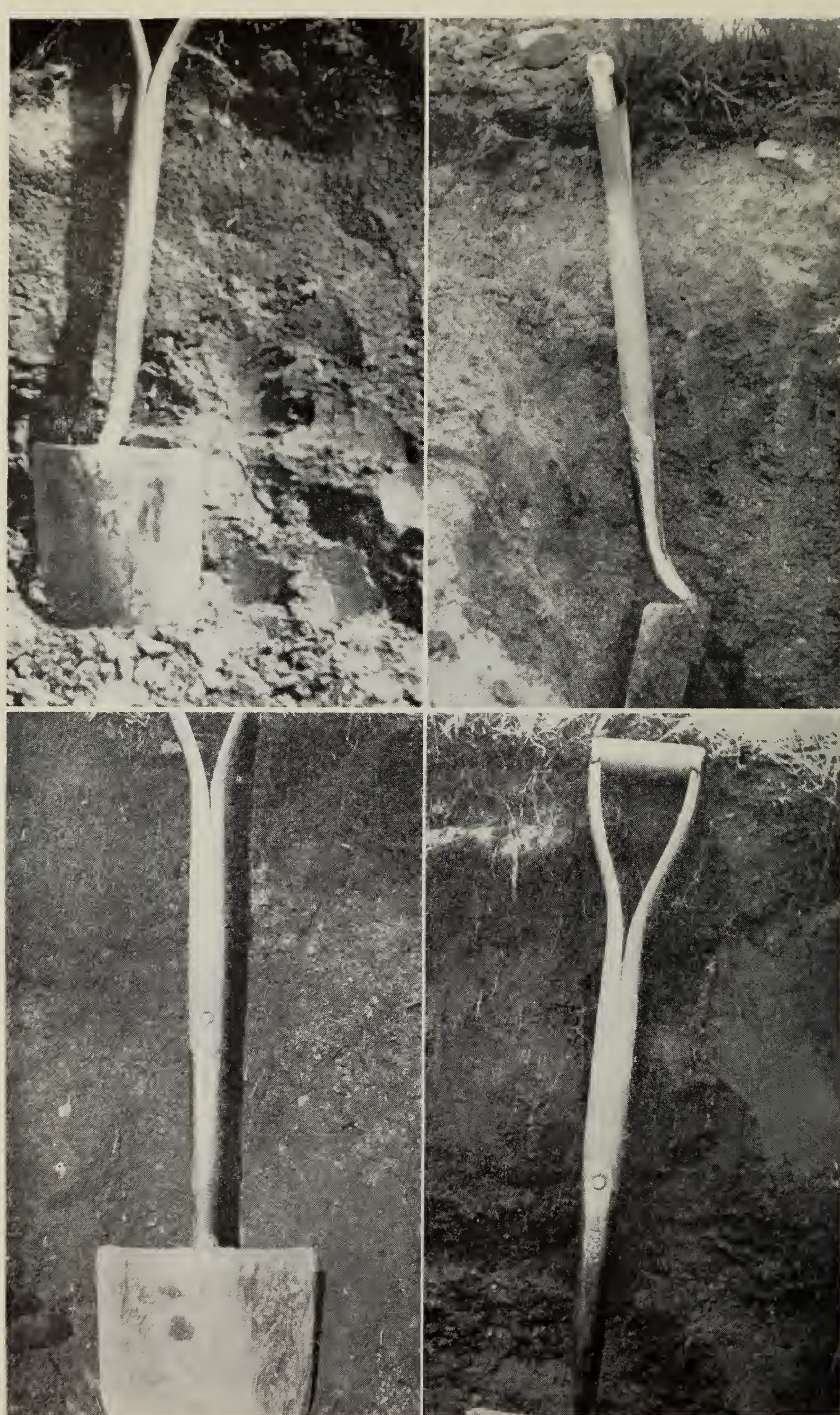
It is an excellent grass soil and will produce 1 to 2½ tons of hay per acre and oats will yield 30 to 40 bushels per acre if the land is not too wet. This type is too high and too wet for success with corn, but millet is a popular crop on this soil. Pasture is poor due to the fact that the land is easily punched full of holes by the tramping of the cattle. In the southeastern part of Compton county, where the slopes are steeper, some severe erosion is taking place making the soil unsuitable for agricultural purposes.

Dufferin Sandy Loam.—This soil type is somewhat similar to the Calais loam, but is more poorly drained and occupies lower positions. It is developed on the same type of till as the Calais and Greensboro soils and occurs in all the counties covering an area of 98,000 acres. A description of a profile showing the variation in the depths of the horizons is given below.

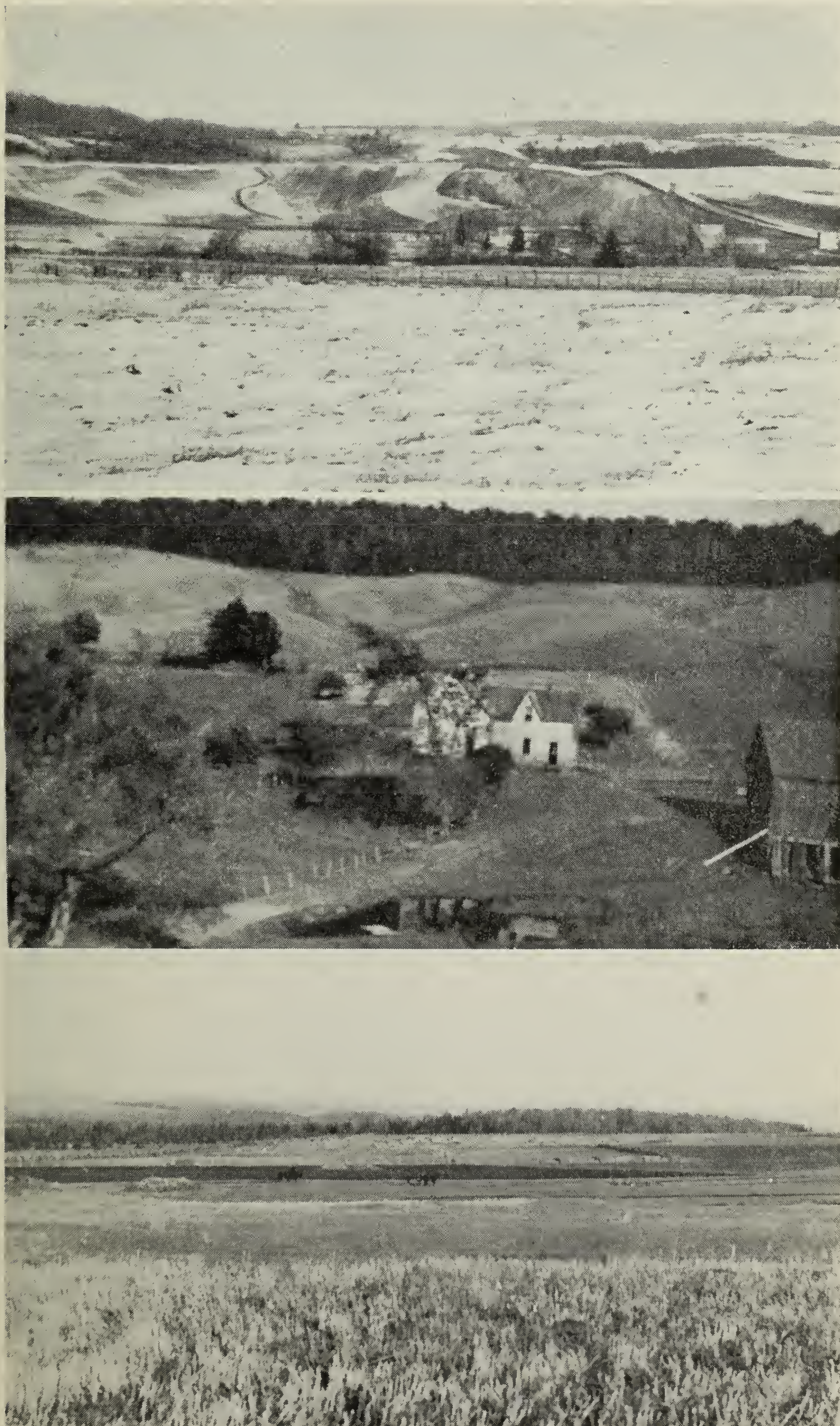
Horizon	Variation in depth	Description
A_0	½— 3″	dark chocolate brown to black sandy loam; weak crumb structure pH 5·5
A_2	2 — 5″	dark grey fine sandy loam; variable in depth pH 5·8
B_1	5 —10″	dark yellow to olive coloured loam; mottled; firm, but not compact; contains black rotted limestone patches; pH 6·0
C	15—90″	dark olive to greenish grey loam; mottled; slightly laminated structure; firm to compact; pH 7·0. May effervesce with acid at a depth of 48-58 inches from the surface.



1. The rolling topography of the Greensboro loam. 2. Profile of the Greensboro loam. 3. Undisturbed profile of Woodbridge loam; note absence of grey leached layer and the presence of compacted subsoil.

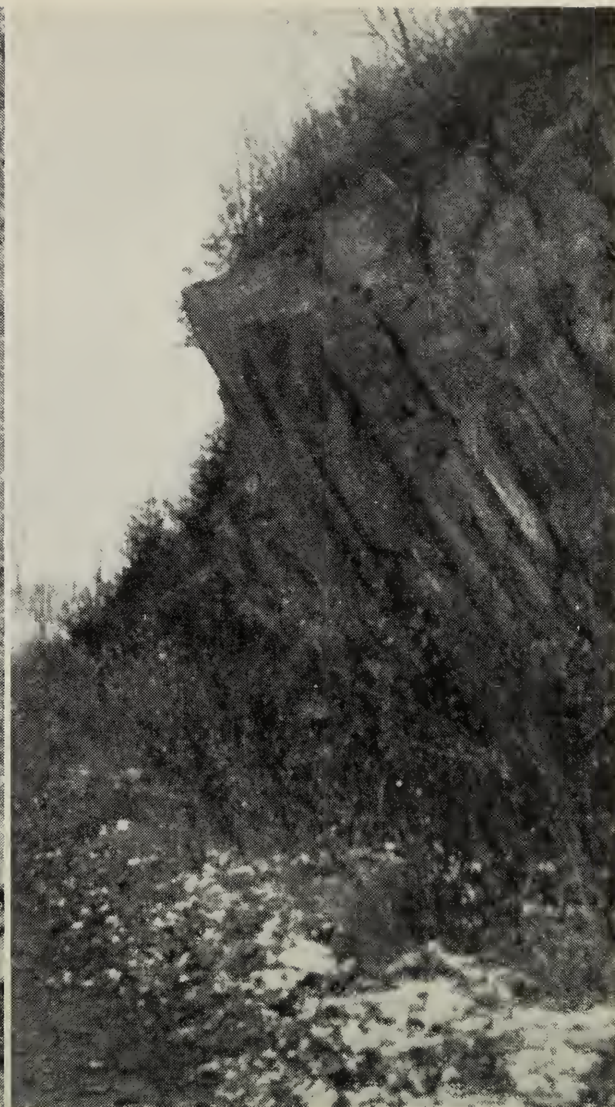


1. Coaticook clay loam virgin profile. 2. Magog stony loam. Note leached layer. The subsoil is a mottled yellowish grey sandy loam to loam. 3. Profile of Calais loam. This profile has a dark green colour. 4. Profile of Colton fine sandy loam.

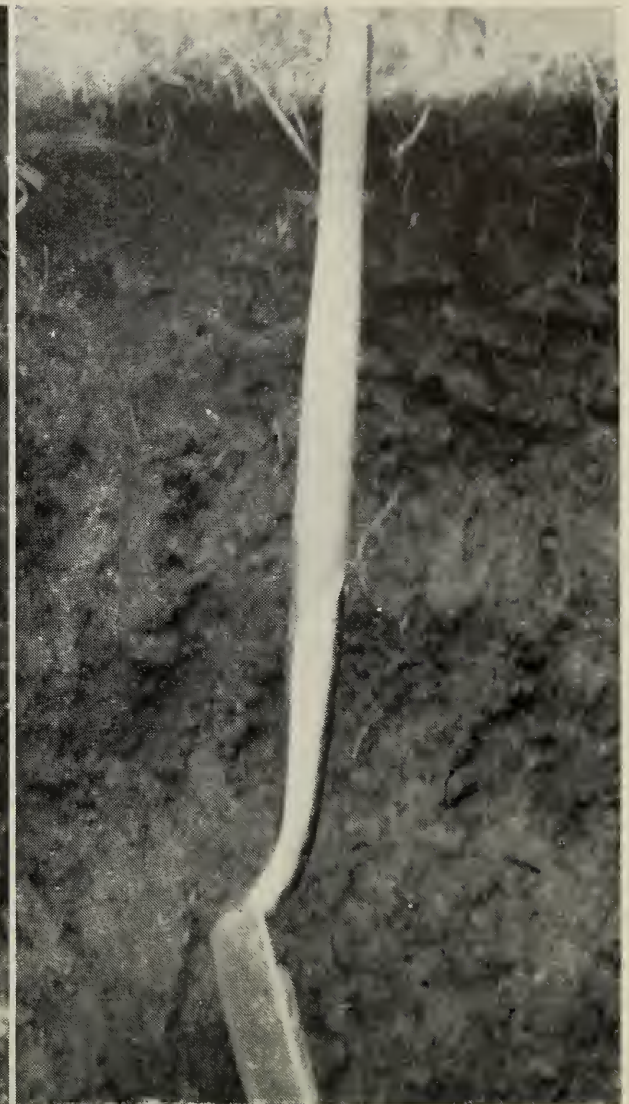


1. Outwash deposited in the valley of the St. Francis river. Berkshire soils on the higher slopes. Sheldon soils in the valley. 2. Abandoned farm on severely eroded hillside. 3. Topography of the Calais loam.

Profile of Berkshire loam.



Outcrop of slate and interbedded limestone from which the Greensboro, Calais and Dufferin soils are developed.



Profile of Dufferin sandy loam.

The cultivated soil has a black sandy loam surface to plough depth which is often streaked with grey patches from the A_2 horizon. From the analytical data given in table XIII, it may be seen that the surface of this soil has several characteristic features. The high moisture-holding capacity and organic-matter content is outstanding and this results in a high content of nitrogen and phosphorus, which is largely in organic form. The calcium content is also very high and is higher throughout the profile than in the Greensboro and Calais soils. Since the drainage of the soil is poor, the soluble phosphate from the surface tends to accumulate in the lower horizons to a greater extent than in the well-drained soils. The vegetation consists of cedar, hemlock and spruce, with some poplar.

Agriculture.—The high moisture-holding capacity of the soil keeps it cold for long periods, microbiological activity is hindered and the level topography on which the type occurs makes it difficult to drain. After the soil has been under cultivation, its physical condition improves, but the lateral movement of water in the soil is very slow and it is often necessary to put drains close together in order to obtain best results. Ploughing breaks up the tough A_2 horizon and facilitates the movement of percolating water.

The Dufferin sandy loam is used chiefly for hay and pasture. Hay produces about one ton per acre on the average, but in the eastern part of Stanstead county there are some well developed areas of this soil on which very good crops of clover, timothy and grain are grown and yields exceed this figure. The pastures are usually poor and contain a large proportion of sedges, but some white clover is seen and these pastures on this soil type respond very well to fertilization. In the vicinity of Sawyerville, the grain crops do not seem to do well on this type. They are stunted and often no grain develops.

Soils Developed on Till Derived from Pre-Cambrian Schists

Berkshire Loam.—The Berkshire loam occurs chiefly in Richmond county and in some small areas in the other counties and occupies an area of 107,000 acres or 7·6 per cent of the total surveyed area. A description of a profile showing the variations in depth of the horizons is given below.

Horizon	Variation in depth	Description
A_0	0 — ½″	leaf litter.
A_1	½— 1″	black sandy loam; friable; crumb structure; pH 5·4
A_2	½— 1½″	grey fine sandy loam; often absent; slightly platy structure pH 5·2
B_1	½— 1″	dark coffee coloured loam; often absent; pH 5·8
B_2	8 —12″	dark yellow to brown mellow loam; fluffy; some stones; darker root patches pH 6·3
B_3	8 —10″	yellow fluffy loam; some stones; firm; pH 6·5
C_1	5 — 8″	compact yellowish grey sandy loam altered till; pH 6·5
C_2	15 —30″	dark grey compact till; contains stones of greenish grey schist pH 6·8

The Berkshire loam resembles the Greensboro loam in appearance, but is derived from different material and is not usually so heavily podsolized as the Greensboro soils. In the surveyed area it is rather a transition soil from the Podsols to the Brown Podsolic soils, varying in its degree of leaching in different places. In the southwest part of Richmond county and the western part of

Sherbrooke county, the soil is shallow and has many rock outcrops, making it unsuitable for cultivation and in the vicinity of North Stoke, the type is often intimately mixed with the Ascot soils. The tree cover consists of maple, grey birch, yellow birch, beech, elm, and some spruce.

From the analyses in table XIII it is evident that these soils differ very little from the Greensboro soils in composition. They contain more calcium and are less leached and the nitrogen, phosphorus and potash are more evenly distributed throughout the profile than in the Greensboro soils.

Agriculture.—The cultivated soil has a brown mellow loam to plough depth which is underlain by a yellow friable loam. Only the smoother areas are cultivated and the steeper slopes are stony and usually in forest, so that lumber furnishes a source of revenue from this soil type. The yields of hay and grain on this type are variable and depend greatly on soil management. Timothy and red top produce 1 to 1½ tons of hay per acre and oats yield from 30 to 35 bushels per acre. Some corn and potatoes are grown, but not in commercial quantities, and these crops seem to do well. The pastures found on this soil type contain considerable creeping bent grass together with Kentucky blue and poverty grass. In the poorly-grazed areas, the pastures are growing up to spiræa and birch sprouts. Very little of the Berkshire soils is suitable for cultivation in the surveyed area and pasture is the chief use of the type, while some of the cleared areas should be allowed to revert to forest.

BLANDFORD LOAM.—The Blandford loam does not occur to a large extent in the surveyed area, but is found in small areas in three of the counties. It is most prominent in Richmond county and has an area of 8,540 acres. This type lies below the general level of the Berkshire soils and occupies smoother areas. A description of a typical profile showing the general variation in the depths of the horizons is given below.

Horizon	Variation in depth	Description
A_0	0 — ½″	leaf litter
A_1	½— 1 ″	dark brown to black sandy loam; weak crumb structure; pH 5·2
A_2		usually absent or just a trace
B1	5 — 7 ″	dark brown to yellowish brown loam; some stones of sandstone and schist material pH 5·6
B_2	12 —16 ″	light yellowish brown to olive coloured loam; friable, almost fluffy; stones of sandstone, slate and schist; pH 5·5
C	15 —30 ″	compact dark grey to light yellow sandy loam till; slightly mottled; contains small angular schist fragments. pH 5·7

In many places the B_1 horizon becomes a reddish brown and much dark slaty schist is found in the profile. The vegetation consists of maple and birch almost entirely.

Agriculture.—The cultivated soil is a brown loam to a depth of 5 to 7 inches, where it grades into a lighter-coloured subsoil of the same texture. Drainage is good except in some places where the soil is shallow and has a compact subsoil or bed-rock is near the surface. This soil seems to be very well suited to the production of grass and excellent hay crops are grown. Hay yields 1 to 2 tons per acre and grain (oats) 35 to 50 bushels per acre, where the land is under good

management. Clover may be grown with success on this type and alfalfa will do well if properly fertilized and handled. Potatoes yield upwards of 100 bushels per acre and corn seems to produce a good crop also and this type ranks with the Greensboro soils in being suited to a variety of crops and is probably superior as a grass soil. Many of the pastures are undergrazed and are growing up to spiræa or hardhack, the chief grasses consisting of bent grass, Kentucky blue and poverty grass.

WOODBRIDGE LOAM.—The Woodbridge loam is not of much importance in the surveyed area and occupies only 100 acres in Compton county, most of which is in forest. The profile described below is typical of the Woodbridge soils and shows the general variation in the depths of the horizons.

Horizon	Variation in depth	Description
A_0	0 — 1 ″	leaf litter and matted roots
A_1	½″	black loam; crumb structure pH 4·0
B_1	4 — 6 ″	grey brown to brown loam; granular structure; some stones of sandstone and schist; pH 4·7
B_2	7 —10 ″	light yellowish sandy loam; firm; pH 5·1
C	15 —38 ″	compact yellowish grey sandy loam; mottled; stones of sandstone and schist; pH 5·6

These soils are acid throughout and their chief characteristic is their compact substratum. Drainage of the upper horizons is fairly good, but water passes along the top of the compact subsoil, which is impervious to both water and roots. The tree cover consists of maple, birch, ash, basswood and occasional white pine.

Agriculture.—The cultivated soil develops a brown surface soil to plough depth and on some of the steeper slopes the soil is browner due to slightly better drainage and possibly also to erosion. The topography is gently sloping, although some steep slopes occur on this type. When cleared, the Woodbridge soils are suitable for grass, but are not very well suited to other crops, especially those which are deep rooted. It furnishes a fair pasture of bent grass, Kentucky blue and poverty grass and some white clover.

Soils Developed on Till Derived from Schistose Material Containing Considerable Serpentine

ORFORD SANDY LOAM.—The Orford sandy loam is the only type of soil to fall in this class. The largest areas of the type occur in Sherbrooke and Richmond counties, where the soil lies along the lower elevations of the Sutton mountain ridge and it occupies an area of 27,000 acres. The profile described below shows the variation in the horizons of the Orford sandy loam.

Horizon	Variation in depth	Description
A_0	0 — 1 ″	black, semi-decomposed organic material
A_1	½— 1 ″	black sandy loam; pH 4·8
A_2	½— 1 ″	grey sandy loam leached layer; pH 4·8
B_1	2 — 4 ″	dark yellow to ochre coloured loam; stones of various sizes; pH 4·9
B_2	8 —10 ″	greyish white sandy loam; stones of diorite and serpentine; mottled; pH 6·4

Horizon	Variation in depth	Description
B_3	6 —12 ″	dark grey compact gravelly sandy loam; mottled; stones of diorite and serpentine; pH 6·8
C	15 —20 ″	firm dark grey gravelly sandy loam till; some boulders; stones of serpentine, quartz and slaty schist; pH 6·8

The till of this soil contains considerable serpentine and this is reflected in the chemical composition of the soil. The chief characteristic of this soil is its whitish-coloured B_2 horizon, which in some places resembles a leached layer. From table XIII it may be noted that there appears to be a marked difference in chemical composition between the three upper horizons and the three lower ones. There is a sudden change in pH, an increase in phosphorus and a marked increase in magnesium. There is considerable difference in the chemical composition of the B_1 and the B_2 horizons, which would lead one to believe that something in the nature of a buried profile exists here.

Agriculture.—Only small areas of this type have been cultivated and it is mostly in bush, the principal vegetation consisting of a mixed stand of maple, birch, spruce and poplar. This soil type is quite stony, but the stones are small and do not interfere with cultivation. Where it has been cultivated, it develops a brown sandy loam surface soil to plough depth and compares favourably with the Berkshire soils as a grass soil, but not much information is available on its suitability for other crops. It would appear that its high content of magnesium might give some trouble to other crops, especially if the B_2 horizon is close to the surface. Drainage varies from fair to poor, but is usually good enough to permit the growth of crops without the need of underdrainage.

Soils Developed on Till Derived from Cambrian Slates and Sandstones

Racine Sandy Loam.—The Racine sandy loam occurs in association with the Berkshire and Blandford soils, but is developed from quartzitic and slaty material. It occupies about 30,000 acres of the surveyed area and lies chiefly in Richmond county. The profile described below shows the variations in depths of the horizons and is typical of this soil type.

Horizon	Variation in depth	Description
A_0	0 — ½″	leaf litter
A_1	½— 1 ″	black sandy loam; friable; crumb structure; pH 4·4
A_2	½— 1 ″	grey loam; weak platy structure; pH 4·6
B_1	1 — 3 ″	dark red to coffee coloured sandy loam; often absent; pH 4·4
B_2	4 — 6 ″	dark reddish brown sandy loam; some stones of slate and sandstone pH 4·4
B_3	8 —12 ″	dark yellow to olive coloured loam; slightly mottled; pH 4·9
C_1	6 — 8 ″	light yellowish grey sandy loam modified till; firm to compact; stones of greenish grey sandstone, pH 6·6
C_2	12 —20 ″	compact, unaltered sandy loam till; pH 6·8

The B horizon varies in texture from a sandy loam to a loam and usually the coffee coloured layer is absent and the horizons are not so distinct as in this profile. The soil is leached and resembles the Ascot soils to some extent. The organic matter and nitrogen is high in the B_2 and B_3 horizons, but the content of phosphorus and potash is about the same as the other soils of the area, although the available phosphorus is very low.

Agriculture.—The cultivated soil has a brown sandy loam surface soil to plough depth, underlain by a light brown layer which grades into the yellowish grey substratum at a depth of about 15 inches. The topography varies from level to gently undulating and on the undulating topography the water tends to collect in the hollows and many wet spots are found. Most of this soil type is cleared, but very little of it is under cultivation and its chief use is for pasture. The vegetation consists chiefly of maple, grey birch, beech and hemlock. It is a poor grass soil, probably due to its acidity and lack of available phosphorus. Lime and phosphorus are badly needed on this soil before crops can be grown. Corn seems to be grown with variable success depending on the season and grain does not give very good yields. Potatoes give a fair crop and this soil should be quite well suited for this crop if fertilizers are used.

Brompton Stony Loam.—The Brompton stony loam is found chiefly in Richmond county and occupies about 48,000 acres of the surveyed area. A description of a profile showing the variations in the depths of the horizons of this soil type is given below.

Horizon	Variation in depth	Description
A_1	0 — 5 ″	black loam; weak crumb structure; pH 5·2
A_2	2 — 7 ″	compact greyish yellow to white sandy loam; numerous small stones; pH 5·4
B	10 —15 ″	yellowish grey stony loam; mottled; some cobbles; firm to compact; sometimes quite sandy; pH 6·2
C	15 —50 ″	yellowish grey sandy loam; mottled; firm to compact; some stones of slate and sandstone, pH 6·8

In most cases there is no sharp line of demarcation between the B and C horizons, but in the better-drained places there may be a trace of a brown B_1 horizon. This soil type occurs on the same type of topography as the Magog stony loam and resembles it somewhat, but has a tendency to be much sandier and to show the influence of weathered sandstone more strongly. It has an average content of nitrogen, phosphorus and potash, although it is not so well supplied with these elements as the Magog stony loam. The surface and internal drainage are poor unless the soil occupies a slope where surface run-off is facilitated, but in spite of its poor drainage, the organic matter does not seem to accumulate on the surface.

Agriculture.—Large areas of the Brompton stony loam have been cleared and the enormous stone piles in the fields are evidence of the labour required to clear this soil type. The tree cover consists of maple, elm, beech and small birch, together with some poplar and spruce. When this soil is cleared, it has a greyish brown loam surface soil to plough depth, which is full of small stones of a diameter of one to two inches. Hay and grain are the chief crops grown and large areas are in pasture which are usually undergrazed and growing up to birch sprouts and spirea. It is necessary to break this soil frequently in order to prevent it from becoming compacted as it tends to settle after the stone is removed and to form a compact layer under the surface, probably due to the

finer material being washed down and filling the pore spaces. Mixed hay yields about 1 to 1½ tons per acre on this soil and oats about 30 to 40 bushels per acre if the soil is properly managed. Better results are obtained with the use of fertilizer and this soil responds very well to phosphate fertilization. The pastures are generally poor on this soil type, but with a little fertilization they improve rapidly and most of the pasture areas on this type could be greatly improved.

Brompton Stony Gravelly Loam.—The Brompton stony gravelly loam does not occupy a very large area, being confined to about 1,400 acres on the western slope of Stoke mountain. It differs from the normal stony loam in having a quantity of gravel in the profile, particularly in the B horizon. Due to its more open nature, the gravelly stony loam is slightly more leached than the normal type and the A_2 horizon is somewhat deeper. The till is usually compact and contains patches of sand and gravel and the profile has about the same acidity as the normal loam. The vegetation consists of maple, beech, grey birch, elm, spruce and hemlock, usually in mixed stands.

Agriculture.—The topography varies from level to gently undulating and the surface drainage is fairly good. Occasionally the surface is covered with sandstone boulders and in some places there are grey shaly outcrops, but where the soil has been cleared and cultivated, the surface is a brown loam with some gravel in it. It has about the same crop value as the normal soil described above, but the greater part of it is in pasture or forest.

Soils Developed on Till Derived from Granite and Gneiss

Becket Stony Loam.—The Becket stony loam is found chiefly along the International Boundary in Stanstead and Compton counties and has an area of about 16,000 acres. It occupies similar topography to the Greensboro and Calais soils, although somewhat rougher, and occurs at a high elevation. A description of a typical profile is given below, showing the variations in the various horizons.

Horizon	Variation in depth	Description
A_0	0 — ½″	leaf litter.
A_1	½— 1 ″	black fluffy loam to sandy loam; pH 4·4
A_2	1 — 2 ″	grey fine sandy loam; slightly platy structure; pH 4·4
B_1	1 — 2 ″	dark reddish loam; friable; weak crumb structure; pH 4·7
B_2	8 —10 ″	dark yellow to ochre coloured loam; becomes lighter in colour with depth; slightly mottled above the substratum; pH 5·4
C	20 —30 ″	grey loam till, often compact, pH 6·6

In some places along the International Boundary, the soil is more heavily leached than described above and a well developed A_2 horizon is seen. The Becket soils do not differ greatly from the Greensboro soils except in acidity and lack of calcium. The tree cover consists of maple, birch, beech, ash and spruce, while spiræa and poverty grass are common on the pasture areas.

Agriculture.—At one time there were quite a number of farms on this soil type, but many of these have been abandoned and are growing up to birch sprouts. The rough and broken topography is usually covered with granite boulders which interfere with cultivation, so that most of the land is used only for pasture. The fairly compact substratum of these soils tends to hold up the moisture and there are many wet depressions throughout the area of this soil type.

Very few crops are seen on the Becket stony loam and it is for the most part in forest and should remain so.

The smoother areas of the Becket stony loam are occupied by the Becket loam, but such areas are small and not of great agricultural importance. Some crops are grown on these areas, but the soil is not suited to deep-rooted crops and hay and grain are about the only crops grown. Hay yields about ½ to 1 ton per acre and oats 30 to 35 bushels per acre. Potatoes will do well if fertilized.

Soils Developed on Till Derived from Non-calcareous Slates and Shales

Ascot Sandy Loam.—The Ascot sandy loam is found chiefly in central Sherbrooke and Richmond counties and in the northern part of Stanstead county and occupies an area of about 64,000 acres. A description of a typical profile showing the variations within the horizons is given below.

Horizon	Variation in depth	Description
A_0	0 — ½″	leaf litter
A_1	½— 1 ″	black to dark brown sandy loam; loam; weak crumb structure; pH 5·0
A_2	1 — 3 ″	grey loam; variable in depth; slight platy structure; pH 5·3
B_1	5 — 8 ″	reddish brown to ochre coloured sandy loam; granular structure; some slate fragments; pH 5·6
B_2	8 —10 ″	dark yellow sandy loam; friable; many roots; slate fragments; pH 6·0
C	20 —36 ″	greyish sandy loam till; compact; fragments of slate and small pieces of sandstone. pH 6·4

The reddish coloured B_1 horizon is very characteristic of this soil. It is deeper than the B_1 in the Becket soils and has a distinctly coarse feeling when rubbed between the fingers. There is not much stone in the profile and the drainage is usually good. The Ascot sandy loam contains slightly more magnesium, calcium and potash, but less phosphorus than the Becket soils. It is better supplied with phosphorus than the Racine sandy loam with which it is often associated and is more sandy than either the Becket or Racine soils. The vegetation consists of maple and white birch.

Agriculture.—The topography of this type varies from rolling to hilly and the surface is broken by numerous rock outcrops. Consequently, this soil is widely used for pasture. When cultivated, the surface soil becomes a brown sandy loam to a depth of six inches and often has some slate and shale fragments mixed in it. The Ascot sandy loam does not seem to be well suited to grass or grain crops and hay yields are very poor in comparison with the other soils of the area, but corn seems to grow as well on this soil type as on most of the other types in the area. The dominant grass in the pastures appears to be Kentucky blue grass, but most of the pastures are in poor condition and undergrazed, and moss hummocks, spiræa and birch sprouts flourish.

Ascot Shaly Sandy Loam.—This soil type is found along the eastern side of Lake Memphremagog and in northeastern Richmond county and has an area of about 15,000 acres. It resembles the normal sandy loam, but differs in having a quantity of angular shale fragments in the profile. The B_2 horizon is often very shaly and practically no soil is present, especially if the bed-rock is close to the surface. There are many rock outcrops on this soil type and where the bed-rock is close to the surface, it is not uncommon to see small pools of water standing in the large cleared fields. In some cases this renders good fields useless for anything but pasture.

Most of this type is used for rough pasture or is in bush. Hay crops are poor and grain gives poor yields, but potatoes seem to produce a fair crop as the soil is very acid and the shaly sandy loam surface soil seems to be well suited to this crop. Possibly with the use of fertilizer, potatoes might prove a successful crop on this soil type.

Sherbrooke Sandy Loam.—The Sherbrooke sandy loam is found mostly in Compton county and occupies an area of about 46,000 acres. A typical profile of this soil type showing the range in depth of the horizons is described below.

Horizon	Variation in depth	Description
A_0	0 — ½″	leaf litter
A_1	½— 1 ″	black sandy loam; weak crumb structure; pH 4·7
A_2	1 — 1½″	purplish grey loam; variable in depth; pH 4·8
B_1	3 — 5 ″	dark reddish brown loam; friable; grades through a yellow colour to B_2; pH 4·7
B_2	8 —10 ″	yellow to olive-coloured loam; some large stones; pH 5·0
C_1	4 — 6 ″	pale yellowish grey loam; altered till; firm, but not compact; some slate fragments; pH 6·0
C_2	20 —36 ″	dark olive grey loam; firm; slate fragments; pH 6·4

Under deciduous forest the brown B_1 horizon is usually thin and is underlain by a deep, light yellow coloured B_2 horizon. Chemical analysis shows that this soil type has about the same composition as the Ascot soils differing only in having less calcium and phosphorus and physically it is not so sandy. The vegetation consists of maple, birch and some elm.

Agriculture.—The Sherbrooke sandy loam is found on smooth, gently undulating topography and usually has about the same elevation as the Racine soils. The cultivated soil has a surface of 6 to 8 inches of brown mellow loam and the profile is quite free from stone, so that it is suitable for the use of all types of farm machinery. This soil type responds well to phosphate fertilization, but phosphate needs to be applied about every two years. A 2-12-6 gives good results on this soil with hay and grain. The Sherbrooke sandy loam produces a better grass and grain crop than the Ascot soils, even though it is not so well supplied with nutrients. Most of the type is under cultivation. Hay yields about 1 ton per acre and oats about 40 bushels per acre on the average.

A small area included with the Sherbrooke sandy loam near Bury contains considerable gravel in the profile. At present this soil is all in bush and is not used except for rough pasture. It has no agricultural possibilities. The profile is similar to that of the normal loam, but the horizons are full of gravel and the B horizon is quite compact. The topography varies from level to undulating and the surface is quite stony.

Sherbrooke Sandy Loam Heavy Subsoil Phase.—This variation in the Sherbrooke sandy loam is confined to an area in the vicinity of East Angus and covers an area of 2,000 acres. It is associated with the Sherbrooke sandy loam on the one hand and the Coaticook clay loam on the other and is a transition type between the two. The profile resembles that of the Sherbrooke sandy loam and differs only in that the B_2 horizon rests on a grey stony clay till, which tends to restrict the drainage.

When cultivated, the surface soil becomes a brown sandy loam to plough depth, except where the drainage is not good, in which case the surface is black.

Tree cover consists of maple, spruce, birch, poplar and occasional white pine. The soil tends to hold the moisture after a heavy rain and the wooded areas are wet even in dry periods. It grows a fair crop of grass, about equal to the normal soil, but due to its usually poor drainage, grain usually gives poor yields. Very little of this soil type is cultivated and the greater part of it is in bush.

Magog Stony Loam.—The Magog stony loam resembles the Brompton stony loam described above and occurs on similar topography. This soil type occurs extensively in all four counties and occupies an area of 152,000 acres and is the third largest soil type in extent. A description of a typical profile showing the variations in depth within the horizons is given below.

Horizon	Variation in depth	Description
A_1	0 — 2 ″	black loam, containing much semi-decomposed organic matter; pH 5·4
A_2	4 — 6″	grey compact loam; full of small angular slaty stones and sandstone pebbles; pH 5·5
B_1	8 —15 ″	dark greyish mottled loam to sandy loam; some stones; pH 6·4
B_2	25 —75 ″	dark yellow to olive coloured loam; firm; mottled; some slaty stones; pH 6·8

This soil differs from the Brompton stony loam in having a tightly compact, very stony layer close to the surface which is difficult to dig through, while the soil under the compact layer is quite friable and loose. Most of the stone in the profile is concentrated in this compact layer and the chief difference in stoniness between the Brompton and the Magog soils lies in this concentration of stones in the A_2 horizon of the Magog soils. In some places the upper horizons are sandier than those described above and there are patches of clay in the B_2 horizon, while occasionally the B_1 horizon assumes a brown colour where the soil is very well drained. From the chemical analyses in table XIII it is evident that this soil is well supplied with nutrients. It has a high content of available phosphorus and is better supplied with calcium and magnesium than either the Brompton or the Dufferin soils.

Agriculture.—When the Magog stony loam is cultivated, it develops a characteristic greyish white appearance on the surface, which may often be recognized from long distances. The topography varies from level to undulating and the drainage is poor, except on some of the sloping hillsides. Clearing of this type is tedious but not difficult and there are huge stone piles in the cleared fields. It tends to become compacted after cultivation much like the Brompton soils and must be broken up every two or three years for best results but when cultivated and well drained it will produce as good, if not better, hay and grain crops than any other soil in the area. It seems to be a strong soil for grain, probably on account of its available phosphorus. Considerable areas are in pasture, which are mostly grown up to birch sprouts, moss hummocks and spiræa. The vegetation is chiefly maple, birch, spruce and poplar. Poplar seems to be more prevalent on the Brompton soils than on the Magog soils. Hay will yield 1 to 1½ tons per acre and oats 35 to 50 bushels per acre on land that is well drained. Corn does not do well on this soil type and very little is grown, but it seems to be suitable for roots.

Magog Stony Sandy Loam.—This phase of the Magog stony loam is not of much importance in the area. It includes an area of sandy, poorly-drained soils associated with the normal stony loam in scattered areas and occupies about 4,000 acres in total. The profile is somewhat similar to the normal stony

loam, but the B horizon is composed of yellowish brown, mottled sandy loam which becomes heavier with depth and rests on a compact grey loam till. In the better-drained places the B horizon may be a brown colour and vary in texture from a fine sand to a sandy loam. Nearly all of this type is covered with trees of poplar, spruce, tamarack, red maple and cedar and is quite swampy in appearance. No crops have been seen on this soil type and where it is cleared it is used for pasture.

Soils Developed on Glacial Outwash

Soils Developed from Sandstone and Slaty Materials

St. Francis Loamy Sand.—The St. Francis loamy sand is confined to an area of about 7,000 acres in Richmond county, most of which lies near the town of Danville. This soil seems to be of more recent origin than the Colton soil described below and is not so well developed. A description of a profile showing the variation in depth within the horizons is given below.

Horizon	Variation in depth	Description
A_1	0 — 6 ″	brown loamy sand; granular structure; pH 5·2
A_2	1 — 1½″	grey fine sand often absent; pH 5·2.
B_1	8 —10 ″	dark brown to reddish brown loamy sand; granular structure; pH 5·7
B_2	8 —15 ″	yellow loamy sand; granular structure; pH 5·7
C	20 —80 ″	pale yellow or grey sand with some gravel; usually not stratified; pH 5·8.

The underlying gravel is not so distinctly stratified as in the Colton soils and the profile is usually deeper before the gravel is reached and in some places the sand shows evidence of having been worked by the wind. This soil is intimately associated with the Shipton sandy loam described below and it is often difficult to separate them. Where tree cover exists, it consists of birch, poplar and some white pine.

Agriculture.—The topography of this soil varies from undulating to rolling. The soil is not so heavily leached as the Colton soils. Drainage is good and in some places, excessive, but in general the soils hold more moisture than the Colton soils, and are slightly better for crop production. Most of this type has been cleared and is in hay or pasture. Small areas of grain and some corn are grown but these crops do not produce heavily unless considerable fertilizer is used. Potatoes are a suitable crop for this soil and will produce 100 to 250 bushels per acre or more if fertilizer is used and some large acreages of this crop have been seen in the vicinity of Danville. The pastures furnish poor grazing and are chiefly in poverty grass, but they may be improved with proper management and fertilization.

Soils Developed from Granitic and Gneissic Materials

Danby Gravelly Sandy Loam.—This soil type occurs in Stanstead and Compton counties in scattered areas and covers about 18,000 acres. In forested areas, the profile has a 1 to 2 inch layer of purplish grey sand under the forest duff and this is underlain to a depth of 12 to 15 inches by a brown to yellowish brown gravelly sandy loam, which grades through a pale yellow, loose and open, gravelly sandy loam to layers of sand and gravel at a depth of 22 to 30 inches. The gravel at this depth varies from cobble size to small boulders and is some-

times coated with carbonate material. Some slate and limestone fragments are also found, but these are scattered. The acidity varies from a pH of 5·3 in the surface to a pH of 6·1 in the lower subsoil. The Danby soils appear to be well supplied with nitrogen, phosphorus and potash, but calcium and magnesium are low. Birch and maple form the dominant tree cover.

Agriculture.—The Danby soils are not very suitable for agricultural purposes, chiefly because of their excessive drainage and consequently not very much of these soils is under cultivation. Hay and grain crops are poor and the pastures are grown up to poverty grass. The chief use of this type is as a source of road gravel and for construction purposes.

COLTON FINE SANDY LOAM.—The Colton fine sandy loam is developed on old terraces along the stream courses throughout the area and covers about 20,000 acres, most of which is found in Stanstead county. A typical profile is described below showing the variation in the depths of the horizons.

Horizon	Variation in depth	Description
A_0	0 — ½"	—loose litter, leaves, etc.
A_1	½— 1 "	—black fine sandy loam; granular structure; pH 5·5.
A_2	1 — 4 "	—grey fine sandy loam; granular structure; pH 5·4
B_1	10 — 20 "	—brown friable sandy loam; granular structure; becomes lighter in colour with depth and grades into a yellow B_2; pH 5·6
B_2	10 — 12 "	—Pale yellow to grey sandy loam; pH 5·8
C	30 — 60 "	—Loose grey gravelly sand, passing into stratified layers of sand and gravel at 26-30 inches from the surface, pH 5·8
D	30 —120 "	—stratifield sand and gravel

Under the original forest cover the grey A_2 layer is well developed, but as most of this soil type has been cultivated, very few profiles containing the grey layer remain. In some of the areas there is an indurated layer under the A_2 which is 4 to 5 inches thick and where this is present, it holds up the water and prevents the penetration of roots. The Colton soils are often intimately mixed with the Danby soils and in this case have more gravel in the upper horizons. The chemical analysis shows that the Colton fine sandy loam is low in nitrogen, phosphorus and potash, but has an average amount of other nutrients. Birch is the dominant tree cover with some occasional white pine.

Agriculture.—The topography of the Colton fine sandy loam is usually level, but may be undulating in a few places and the drainage varies from good to excessive. When this soil is cultivated the surface becomes a brown fine sandy loam to plough depth and this surface layer seems to be able to hold considerable moisture. The greater part of this soil type is cleared and used for pasture, but there are local areas where hay, grain and corn are grown. Grass and grain give poor yields unless fertilizer is used and lime is also needed. Potatoes will yield 100 to 150 bushels on this soil if fertilized and corn does well also under this treatment. Small fruits and truck crops should do well on this soil if properly handled, and where the soil is not excessively drained, the use of manure, phosphate and potash fertilizers will render it capable of producing good crops.

Soils Deposited on Lacustrine Clay and Developed from Granitic Materials with some Impure Limestone and Slate

Sheldon Sandy Loam.—The main areas of this soil type are found along the principal river courses, particularly along the St. Francis and Coaticook valleys and about 5,000 acres were mapped. A typical profile is described below, and the variation within the horizons is shown.

Horizon	Variation in depth	Description
A_0	0 — ½″	—leaf litter.
A_1	½— 1″	—black to dark brown sandy loam; weak crumb structure; pH 5·4
A_2	1 — 1½″	—grey fine sandy loam; slight platy structure; pH 5·6
B_1	3 — 5″	—reddish brown sandy loam; granular structure; pH 5·7
B_2	10 — 16″	—yellow sandy loam; few small stones; pH 6·2
D	24 —120″	—grey sandy clay to clay loam; nutty structure; calcareous at great depths; pH 6·4

The chief variation in this soil type is the depth to the clay subsoil and in the lower part of the Coaticook valley there is a greenish silty layer in the subsoil. Near Milby, at the junction of the Moe and Salmon rivers, the Sheldon is mixed with the Coaticook clay loam and along the St. Francis valley, north of Sherbrooke, the clay often comes within 15 to 18 inches of the surface. The texture of the surface soil ranges from a fine sandy loam to a sandy loam and even approaches a loam in places. The chemical analyses show that this soil type tends to be lower in nitrogen, calcium and magnesium than the adjacent upland soils and is considerably leached in spite of its clayey subsoil. The forested areas are covered with birch, poplar, maple and spruce.

Agriculture.—The Sheldon soils are free from stones and easy to cultivate and very productive when fertilized. Their natural fertility, however, is low, but better yields are obtained on the Sheldon soils than on the Colton soils, probably as a result of their better moisture-holding capacity. Hay yields 1 to 1½ tons per acre on this type and oats 30 to 40 bushels per acre, while potatoes will yield about 125 to 150 bushels per acre and corn does quite well. With fertilizer these yields may be improved. In some places the Sheldon soils are found on fairly steep slopes and considerable erosion is taking place. These slopes should be left in permanent sod or in trees. Even on the smoother topography the Sheldon soils are subject to erosion when intertilled crops are grown and care should be taken in soil management and crop planning.

Shipton Sandy Loam.—The Shipton sandy loam is often mixed with the St. Francis loamy sand in Richmond county, where it occupies about 10,000 acres. It resembles the Sheldon sandy loam in being deposited on clay, but is usually less leached. A description of a profile showing its variations is given below.

Horizon	Variation in depth	Description
A_0	0 — 4″	— brown sandy loam, weak crumb structure; pH 5·2
A_2		trace of grey fine sandy loam; usually absent
B_1	5 — 10″	— reddish brown sandy loam; granular structure; pH 5·6
B_2	16 — 22″	— light yellow sandy loam; granular structure; pH 5·6
B_3	12 — 15″	— grey sand; pH 6·6
D	30 —120″	— grey silty clay to clay; nutty structure; pH 6·8

The profile is usually deeper than the Sheldon soils due to the heavier deposition of sand in this area and there is little evidence of leaching, the grey layer being difficult to find.

The Shipton sandy loam is better supplied with potash, calcium and magnesium in the upper horizons than the Sheldon soils and the nitrogen is more evenly distributed throughout the profile. The principal tree cover consists of birch, elm and some spruce.

Agriculture.—The topography of the Shipton sandy loam varies from level to rolling and the soils are often badly eroded. Where erosion has been severe, the topography has a "knob and sag" appearance. It is a better crop soil, without fertilizers, than the Sheldon soils and some good crops of timothy and oats are grown, but erosion is a pertinent factor on this soil type and care must be taken with hoed crops such as corn and potatoes even on the more level tracts of land. Nearly all of this type is cleared and much of it is in pasture, while timothy and oats are the chief crops grown.

Soils Developed on Lacustrine Materials

Coaticook Clay Loam.—The Coaticook clay loam is developed from the fine sediments deposited in lakes formed by the damming of streams during the glacial period. Consequently, it is found along the principal river valleys of the area and usually at considerable elevation above the present water level. This type occupies about 40,000 acres, chiefly in the Coaticook valley. A typical profile is described below and the variation in depth within the horizons is also shown.

Horizon	Variation in depth	Description
A_1	0 — 1″	black loam and semi-decomposed organic matter; weak crumb structure; pH 4·5
A_2	1 — 3″	grey clay cloam; structure varies from weak platy to fine nutty; pH 5·0
B_1	8 — 15″	reddish brown to yellowish brown clay loam; small nutty structure; pH 5·0
B_2	10 — 12″	yellowish grey clay loam; firm; slightly mottled; pH 5·8
C	26 —130″	grey clay; massive structure; sometimes laminated; pH 6·6

Some of the included areas contain considerable silt and are lighter in texture than the normal soil In some places in Richmond county, till has been found under the clay, showing that the clay was deposited after the glacial ice left the area. In the vicinity of Kingsbury the clay has a pinkish tinge. Where the type occurs with the Sheldon sandy loam, there are a few places in which the surface soil is a heavy sandy loam. The Coaticook clay loam is as well supplied with nitrogen, phosphorus and potash and the other elements as the other soils of the area. Nearly all of this type has been cleared and the remaining forested areas are covered with elm, maple, birch and spruce.

Agriculture.—The Coaticook clay loam is free from stone and quite fertile and is very well suited to dairy farming. It is, however, subject to severe sheet and gully erosion and its once level topography is cut by ravines and gullies which impart a rolling character to this soil type. After cultivation, the surface becomes a brown clay loam to plough depth, which is underlain by a yellowish

brown clay loam. The chief crops grown are hay and grain and some corn is grown for silage. Corn yields 10 to 15 tons per acre, hay 1 to 1½ tons per acre and oats 35 to 50 bushels per acre on soils of this type. In some of the more level areas, the drainage must be improved in order to grow crops successfully, but generally the soil is sufficiently well drained in its natural state. Some small associated stony areas have been included with this type, but they are unsuitable for agricultural purposes.

Lennoxville Clay Loam.—This soil type does not occur to any great extent in the surveyed area and is usually found on low, poorly-drained places. Only about 500 acres of this type were mapped and a description of a profile is given below, together with the variation in depths of the horizons.

Horizon	Variation in depth	Description
A_1	0 — 6 ″	brown clay loam; crumb structure; pH 6·8
B_1	3 — 4 ″	greyish clay; mottled with brown streaks; massive structure; pH 6·8
B_2	8 —10 ″	grey mottled clay loam; massive structure; pH 7·0
B_3	6 —12 ″	grey heavy loam; cloddy structure; mottled; pH 7·0
C	5 —10 ″	grey coarse sand
D	20 —50 ″	gravel and coarse sand

This soil seems to have been deposited in the shallow embayments of former meandering streams which were subject to periodic flooding. It becomes lighter in texture with depth and the horizons are quite distinct and show the marks of deposition. It is well supplied with nutrients, being equal to any of the soils of the area in this respect. The forested areas are covered with elm and maple on the better-drained parts and spruce, red maple, cedar and scirpus on the more poorly-drained areas.

Agriculture.—The only well developed area of the Lennoxville clay loam occurs on the Experimental Station at Lennoxville. It requires drainage before it can be successfully cultivated and due to its low position is usually subject to early frosts. When well drained, it is suitable for the production of hay, grain, corn and roots and has about the same value as the Coaticook soils.

Soils of the Bottom Lands

Milby Fine Sand.—The Milby fine sand is developed on the flood plains of the several streams throughout the area and occupies about 17,000 acres. The surface soil is a brown, fine sand to a depth of about ten inches and this grades through a pale yellow sand to a grey coarser sand at a depth of 20 to 30 inches. In some places there is considerable gravel in the profile and the Milby soil somewhat resembles the Colton soils. It is derived from a variety of materials, chiefly slaty schist and impure limestone and the surface soil has a pH of 5·0 which changes to a pH of 6·0 at a depth of 15 to 20 inches. The Milby fine sand is a young soil and is still being formed in places and it shows no profile characteristics.

Agriculture.—The topography of the Milby fine sand is level and most of it is subject to flooding at high stages of the rivers and for this reason it is unsuitable for certain crops. The sand is fine enough to hold the moisture during the drier periods of the summer and some areas of this type are well developed. On the wider flats, there are usually wet spots on this type, where it lies farthest from the present river course. Corn, potatoes and market garden crops may be grown on this soil type, but most of the cultivated areas

are used for hay or grain. Hay yields about 1 to 1½ tons per acre and oats about 40 bushels per acre, but it has been observed that grain has a tendency to lodge on this soil type. Early frosts are prevalent and short-season crops are best suited to the Milby fine sand.

Organic Soils

Peat.—The areas mapped as peat occur in low depressions where semi-decomposed organic material has accumulated to the depth of 2½ to 3 feet. In most cases this deposit is fibrous, brownish to blackish material composed of sedges and other plants. Practically no woody peat occurs in the surveyed area. In one place near Waterville, sphagnum moss covers the peat and is being developed commercially Most of the peat is underlain by compact rusty brown or grey sand and is usually very wet and swampy.

Miscellaneous Soil Types

Alluvial Soils—Undifferentiated.—The soils designated as alluvial soils, undifferentiated, occupy low-lying land along the streams. The surface soil usually consists of 6 to 8 inches of brown sandy loam mixed with more or less organic matter, often mucky in appearance. Beneath this the subsoil is a mottled, rust brown coarse sand to a depth of 15 inches, often containing some gravel and cobbles. This in turn is underlain by a mixture of sand and water-rounded and angular stones and often patches of clay. Most of this soil type is poorly drained and subject to flooding. In the drier places, its organic surface makes it suitable for the production of truck crops, but there is very little of this type of land available. Very little of this soil type is cleared and it is covered with a dense growth of spruce, tamarack and cedar.

Rough Stony Land.—The land classed as rough stony land includes areas which are too stony and broken by rock outcrops to be of any agricultural use. Part of this land type is used for rough pasture and the remainder is in forest. The total area occupied by this type is about 98,000 acres or 6·9 per cent of the entire surveyed area Much of this class of land is confined to the three principal ridges, described under topography, but there are also scattered areas which are too rough for cultivation, particularly along the International Boundary. The rough stony land has been divided into different classes according to the soil type with which it is associated. These have been named rough stony land—Ascot soil material, Becket soil material, Berkshire soil material and Greensboro soil material. In these areas the few profiles which are developed resemble those of the normal soil with which they are associated, but they tend to be shallow due to the thin layer of drift over the bed-rock. In some cases these areas furnish good pasture which could be improved with fertilization, but in other areas the slopes are so steep that erosion is taking place and these areas should be allowed to grow back into bush.

Swampy Land.—The areas mapped as swampy land consist of wet, swampy places in which the water is held on the surface of the soil by a compact subsoil or bed-rock. The surface soil usually consists of a 6 to 8 inch layer of semi-decomposed organic matter mixed with considerable mineral material. This is underlain by a compact substratum of sand or till which is impervious to water. Most of these areas are covered with trees of cedar, spruce or poplar and a ground vegetation of sedges, rushes and scirpus.

Fill.—An area in Richmond county has been mapped as fill. This is land that has been covered with the waste products of the asbestos mine and is unsuitable for agricultural purposes.

Soil Erosion

Little attention has been paid to soil erosion in the surveyed area, yet considerable erosion is taking place on some of the soil types. This is especially true of the more intensively cultivated types and anyone who has witnessed the heavy rains which frequently occur in the area during the summer cannot fail to be impressed by the muddy streams flowing across the fields and along the road-sides. Some of this erosion may be controlled by cultural practices, but the more serious types require some engineering skill for successful control.

Soil erosion depends on several factors; the type of soil, the slope, the chemical and physical properties of the soil, the vegetative cover and the amount and intensity of the precipitation all affect the amount of water which will run off over the surface and its rate of flow. The control of erosion is complicated by the fact that different types of soil on the same slope erode differently. Once erosion has reached the rill or small gully stage, it expands rapidly and causes serious losses of valuable farm land. Sheet erosion is undoubtedly causing serious losses of good top soil in the area, but this type of erosion often escapes notice until serious damage is done.

In grouping soils into erosion categories, it is often the practice to group them according to their amount of slope. Five categories are usually chosen, namely A, B, C, D, and E slopes. The A slopes include land which is nearly level or has a slope less than 2½ per cent, that is, a rise of 2½ feet in a hundred. In the surveyed area this would include some of the Coaticook, Sheldon, Colton, Milby, Lennoxville, Magog, Brompton and Dufferin soils which have level to gently undulating topography.

The B slopes range from 2½ to 7 per cent and would include small areas of the Sheldon and Coaticook series, together with a large percentage of the upland soils such as the Greensboro, Ascot, Racine, Calais, Orford, Danby, Sherbrooke, Blandford and Woodbridge soils. These soils are subject to some water erosion with intertilled crops on the steeper slopes, but when in grass or woodland, they are not much affected. Tilled crops such as corn or potatoes are susceptible to considerable erosion on the steeper slopes of this class, particularly on the Sheldon and Coaticook soils.

The C slopes range from 7 to 15 per cent and are subject to severe erosion if under cultivation. The steeper slopes of the Greensboro soils, most of the Becket stony loam and the rougher areas of the Ascot and Berkshire soils are included in this class. These slopes should be left under permanent grass cover or woodland.

The D slopes, ranging from 15 to 25 per cent, and the E slopes, ranging upwards from 25 per cent, should be left in forest. These include the areas classed as rough stony land and the steepest parts of the upland soils. Erosion will vary in each of these classes with the type of soil. The heavier types of soil tend to wash more readily than the lighter soils because of their greater content of finer material.

All types of agricultural practices may be carried out on soils with an A slope without much danger of significant erosion, but care should be exercised with the Coaticook soils even in this class. The B slope soils require a reasonable amount of care and close-growing crops such as hay or grain are best suited to this type of topography. The Coaticook, Sheldon and Calais soils will suffer from sheet washing when on a slope of 4 to 7 per cent, particularly with hoed crops, and the upper limit of the B slope is the steepest on which cultivated crops may be grown without the danger of considerable erosion. The C slopes should not be used for cultivated crops, but grass and grain may be grown up to 15 per cent slope, although here again the type of soil will determine the safety of the practice, and above this limit the land should be in good pasture or forest. The D and E slopes in the surveyed area are fortunately mostly in forest and should remain in this state.

There are large areas on the steeper slopes which are used for pasture and these are often undergrazed and are growing up to hardhack and small trees. It is evident from the vegetation that the soil in these pastures is seriously depleted and in such a condition they are susceptible both to erosion themselves and are unable to hold moisture and hence cause erosion of the lower slopes. The use of fertilizer would greatly improve the sod in some of these pastures and not only increase their feeding value, but also their moisture-holding capacity. The poorer areas should be allowed to grow into forest.

On some farms, small streams are cutting away their banks and washing away valuable bottom land and some type of preventive measure should be established in this case. In general, there is a slight sheet erosion taking place on all of the upland soils which are under cultivation, but this has not reached a serious stage. In the Coaticook and Sheldon and, in some cases, in the Shipton soils, care should be taken to prevent sheet washing, by the use of suitable crops and cultural practices on the steeper slopes.

Agricultural Methods and Management

The climate of the four counties under discussion is suitable for the growth of a considerable variety of crops. Crop practices do not vary widely within the area and the same general types of practices are followed everywhere. Mixed farming may be said to occupy the greatest attention among the agricultural population, but in some of the better-developed areas, and especially near the larger towns, dairying is a specialty. In the more heavily wooded areas, particularly in the eastern section of the counties, where considerable lumbering is carried on, a few cows are kept on every farm. During the past few years there has been an increasing trend towards more dairying and an increase in the production of hogs for market. Farming operations in Richmond, Sherbrooke and Stanstead counties are more intensive than in Compton county and more farms are devoted to dairying. This has led to an increase in the number of silos on farms in recent years and a tendency toward growing more corn for silage. There is a general tendency to plough up hay land after two or three years and to grow a hoed crop, which is followed in turn by grain and hay again. Hay occupies the greatest acreage of cultivated farm land in the area followed by oats and mixed grain and small local acreages of wheat, barley, potatoes and roots are also grown.

The soils of the Greensboro series are probably the most developed in the area and it is on these soils that farming has been carried on longest. The crops grown and the practices followed on the Greensboro soils also apply to the other upland soils of the Berkshire, Sherbrooke, Racine and Ascot series. Hay, grain and corn are the chief crops grown on all these soils and better yields are obtained on the Greensboro soils over a period of years than on the other types. Where hay is grown on these types, the fields are usually treated with manure and, if fertilizer is used in addition, 250 to 375 pounds of 4-8-10 is recommended by the Provincial Fertilizer Council for best results. If both manure and fertilizer are used, mixed hay will usually yield about 1 to 2 tons per acre on the Greensboro soils and slightly less on the other soils. Good yields of corn (8 to 15 tons per acre) may be obtained on the Greensboro, Sherbrooke and Ascot soils, but the Berkshire soils are usually at too high elevation for best success with this crop. Some potatoes and roots are also grown and for potatoes the Provincial Fertilizer Council recommends the use of 800 to 1,200 pounds of 2-12-10 per acre if manure is also used, or more than this if manure is not used. Potatoes will probably give slightly better yields on the Ascot soils than on the other types. The rougher upland soils like the Becket stony loam are used chiefly for pasture.

On the more poorly-drained upland soils of the Calais, Dufferin, Magog and Brompton series, hay is the principal crop grown and yields of 1 to 1½ tons

per acre are obtained. Where the Magog, Brompton and Dufferin soils have been cultivated for years, good yields of grain (30 to 50 bu.) are obtained. The Magog soils seem to be better suited to grain than the other poorly-drained types after they have been cultivated. Drainage is a major factor on these soils. The Blandford soils are excellent for grass and equal to the Greensboro soils if fertilizer is used. They have a smooth topography, are easily cultivated and usually easy to drain. The Woodbridge soils are usually too steep for cultivated crops, but grass may be grown successfully. They are very acid and require liming.

On the lighter soils such as those of the Danby, Milby, Colton, Sheldon, Shipton and St. Francis series, hay and grain give poor yields unless heavily fertilized. The Danby soils are used chiefly as a source of road gravel and are not much cultivated. On the other types, hay yields ½ to 1 ton per acre and oats 25 to 35 bushels per acre unless fertilized. All these soil types require lime and manure is beneficial both as a source of plant food and in increasing the moisture-holding capacity of the soil. Potatoes seem to be well adapted to these soils and the use of 800 to 1,500 pounds of 2-12-10 per acre is recommended by the Fertilizer Council if no manure is applied and slightly less otherwise. For cereals on these soil types good results are obtained when 300 to 600 pounds of 2-12-10 or 2-12-6 per acre is applied according to the recommendations of the Fertilizer Council.

On the soils of the Coaticook and Lennoxville series, corn will yield 10 to 15 tons per acre if heavily manured at the rate of 12 to 16 tons per acre, but roots are a more reliable crop than corn on these soil types, although they cost more to produce according to reports of the Experimental Station at Lennoxville. For cereals the use of 250 to 500 pounds of 20 per cent superphosphate per acre is recommended by the Fertilizer Council.

Grass mixtures sown for hay usually contain timothy, red top and alsike clover with some fescue, oat grass and orchard grass. Timothy and red top seem to be the most consistent grasses for this area, as alsike, fescue, orchard grass and oat grass seem to die out after the first year. The Boon variety of timothy is well suited to the climate of the region. Red clover and alsike have a tendency to winter-kill rather heavily. On well drained soils which are neutral in reaction, or which have been limed, alfalfa will often succeed, but in general, alfalfa has not flourished on the soils of this area.

Banner is the highest yielding oat variety grown in the area, but Legacy and Vanguard also give good yields, the latter sometimes out-yielding Banner. Barley is an earlier crop than oats and gives a lower yield, the chief varieties grown being Charlottetown 80, Mensury and O.A.C. 21. Mixed grain covers considerable acreage, especially in Stanstead county, and the highest yielding mixture has been found to be Charlottetown 80 barley, Huron wheat and Banner oats in the ratio of 36-30-51 pounds per acre. The Banner oat, however, is unsuitable for this mixture as it is difficult to harvest due to the fact that it grows taller than the other grains and the Legacy oat has been substituted.

Some small acreages of spring wheat are grown in the area and Huron, yielding about 34 bushels per acre, seems to be best suited to this region. Sunflowers grown for silage yield more heavily than corn and usually about 21 tons per acre are obtained. Mammoth Russian is the largest yielding variety and Ottawa 76 is nearly as good.

Large quantities of commercial fertilizers are bought in the area. Table XI shows the amounts bought in 1933-34 and this is still increasing. Stanstead county uses the greatest quantity of commercial fertilizer and 16 per cent superphosphate is the most used fertilizer in Stanstead and Compton counties, while the 4-8-10 is more used in Sherbrooke and Richmond counties. There is a tendency at present to restrict the mixtures of fertilizers used to the

2-12-6, 4-8-10, 0-16-6 and superphosphate. Lime is used on some farms but is not receiving the attention it deserves.

Pastures.—Perhaps the greatest improvement in farm practice in recent years has been the greater attention given to the pastures in the area. Most of these pastures consist of those parts of the farm which are cleared, but too rough for cultivation and in many cases the land should have been left in forest. On the other hand, some very good grazing may be provided on some areas by careful management and the use of fertilizers. The fertility of these pastures has been seriously depleted. When the forest is first removed, the pastures seem to have a dominance of the better species of grasses such as Kentucky blue grass and white clover. Subsequent grazing methods—usually undergrazing and lack of proper care—drive out the better species and red top, poverty grass, spiræa and moss hummocks appear. Finally, the tree cover returns and the land is of no use for pasture.

In a survey made by Frankton (6) in Stanstead county in 1939-40, the average cover of farms was noted. This is presented in the table below.

Percentage Cover of Farms—Stanstead County

Type of Cover	Per Cent
Bush pasture	11·3
Low grade pasture less than 40% grass	20·2
High grade pasture over 40% grass	8·9
Hay	19·9
Grain	5·2
Corn	0·8
Other intertilled crops	0·6
Scrub	11·2
Bush	13·5
Forest	6·9
Swamp	1.5
	100·0

The botanical composition of the pastures was also studied. Good grasses and clover occupied 27·6 per cent, poverty grass, 16 per cent, and other useful plants 56·4 per cent of the actual pasture flora. The most useful species in order abundance were found to be red top, red fescue, Kentucky blue grass, white clover and timothy. Rich mixed swards containing clover were far less common than single grass or mixed swards. Red top constantly outyielded Kentucky blue grass and is superior as a single species in this respect.

The improvement of pastures should begin on the better types of land and it would be a good practice to allow the rougher types to go back to forest. Manuring will greatly increase the value of the sward by encouraging the growth of white clover and closer grazing seems essential to keep down the shrub growth. For most soils in the area the use of 400 to 500 pounds of 0-16-6 per acre is recommended for pasture fertilizer by the Provincial Pasture Committee and this should be applied every two or three years, depending on the results obtained. With this treatment and careful grazing management the ordinary farm pasture will become a valuable asset.

In general, the upland soils of this area are very suitable for the production of grain and hay, while the more poorly-drained soils such as the Calais and Dufferin series are better suited to grass than grain. The soils of the river bottoms and the outwash soils are suitable for truck crops and potatoes, except where otherwise noted, and the heavy soils are good grain and hay soils, if they are sufficiently drained. Practically no orchard of any size appears in the area, but there are certain local conditions that are favourable for fruit growing. Dairying is the chief industry and will tend to increase in the future.

TABLE XI.—FERTILIZER USED IN THE SURVEYED AREA—1934

(tons)

County	16% phosphate	16% super-phosphate	20% super-phosphate	Sulphate of ammonia	Nitrate of soda	Nitro chalk	Muriate of potash	Sulphate of potash	4–8–10	2–12–6	6–8–10	2–8–4	All others	Total
Stanstead...	....	115·0	57·2	32·6	0·7	....	7·1	....	107·0	68·0	4·8	41·3	60·9	494·6
Sherbrooke..	....	52·8	33·6	4·1	4·5	0·2	2·7	4·7	200·4	52·9	6·4	7·0	18·9	388·2
Richmond...	6	78·0	46·9	1·8	0·2	....	3·3	....	105·4	49·8	2·8	3·0	8·7	305·9
Compton....	....	119·7	92·5	7·8	2·5	....	16·7	....	107·5	39·8	0·4	42·0	29·4	458·3
Total......	6	365·5	230·2	46·3	7·9	0·2	29·8	4·7	520·3	210·5	14·4	93·3	117·9	1,647·0

"All Others" includes small amounts of 45 mixtures from 0–8–10 to 12–16–20. The figures show an increase of 35% over 1932–33.

Crop Ratings

Comparative ~~Evaluation~~ of the Different Soil Types

The soils of the surveyed area differ considerably in their productivity and in their adaptability for the different crops. In table XII the suitabilities of the various soils for the main crops grown in the area are summarized. The ratings of the soils, such as good, poor, fair, etc., are based on general observations made during several years supplemented with data collected from various farmers and apply where the soils have been well managed. The different ratings serve for comparisons in the surveyed area only, as sufficient information is not available to date to permit an exact quantitative rating which could be used to compare the productivity and suitability of the soils in this area with soils elsewhere.

From table XII it is evident that, in most cases, the soils which are best suited for the production of hay are also good grain soils and the poor grain soils are inferior for hay. The Magog and Brompton soils are somewhat better suited to the production of grain than of hay, but this does not mean that successful crops of hay may not be grown on these soils.

The light soils of the Ascot, Racine, St. Francis, Sheldon and Sherbrooke series are best suited for potatoes and, with the exception of the Sheldon and Sherbrooke soils, are inferior for grain and hay. Most of the good potato soils are inferior for roots. The Greensboro soils, which are the most extensively cultivated soils of the area, will grow a crop of potatoes of sufficient yield to make it profitable to use them in a rotation with grain and hay.

The Coaticook and Lennoxville soils are better suited to the production of roots than the other soils of the area. Some of the soils yielding a fair crop of roots will give a good yield of potatoes but the poorer root soils are also poor for potatoes.

TABLE XII.—CROP ADAPTABILITY OF THE MAJOR SOIL TYPES*

Soil Type	Hay and clover	Oats	Potatoes	Roots	Corn	Pasture
Ascot sandy loam	FP	FP	G	F	G	P
Becket stony loam	P	P	FP	P	P	P
Berkshire loam	FG	F	FG	F	FP	FP
Blandford loam	G	FG	FG	F	G	F
Brompton stony loam	FG	G	FP	FG	F	F
Calais loam	G	F	P	P	P	F
Colton fine sandy loam	P	FP	FG	FP	P	P
Coaticook clay loam	G	G	P	G	FG	G
Danby gravelly sandy loam	P	P	P	P	P	P
Dufferin sandy loam	G	F	P	P	F	F
Greensboro loam	G	G	F	F	F	FP
Greensboro loam—strongly rolling phase	G	G	F	F	FP	FP
Lennoxville clay loam	G	G	P	G	FG	F
Magog stony loam	FG	G	FP	FP	FG	F
Milby fine sand	G	G	F	F	G	F
Racine sandy loam	FP	F	G	FP	G	P
St. Francis loamy sand	P	P	G	FP	FP	P
Sheldon sandy loam	G	G	G	F	G	F
Sherbrooke sandy loam	FG	FG	G	F	G	F
Shipton sandy loam	P	P	F	FP	F	P
Woodbridge loam	F	F	F	FP	P	FP

*G = Good. F = Fair. P = Poor.
FP = Fair to poor. FG = Fair to good.

In general, the soils best suited for corn are also good potato soils, but inferior for roots. Exceptions to this are the Coaticook and Lennoxville soils which are better adapted to corn and roots than to potatoes. The Greensboro soils will grow fair crops of potatoes, corn and roots as well as good grain and

hay crops and this makes it possible to practise a more diversified rotation on these soils. Most of the soils which yield good hay and grain crops are suitable for corn, but inferior for roots and potatoes. Exceptions to this are the Coaticook and Lennoxville soils which are suitable for hay, grain, corn and roots, and the Sherbrooke and Sheldon soils which are adapted to the production of hay, grain, corn and potatoes.

Nearly all the soils have been classified as fair to poor pasture soils. This is due largely to poor management rather than to the potential value of these soils for pasture. Most pastures will respond to good management and fertilizer treatment as has been discussed in another part of this report.

It is difficult to arrange all the different soils in the order of their productivity owing to their differences in adaptability for different crops. However, considering all crops, it can be safely said that such soils as the Coaticook clay loam, the Lennoxville clay loam, the Sheldon sandy loam, the Sherbrooke sandy loam, the Milby fine sand, the Greensboro loam and the Blandford loam are the more productive soils of the area, while the Danby gravelly sandy loam, the Shipton sandy loam, the Colton fine sandy loam, and the Becket stony loam are definitely inferior.

Summary

The four counties of Stanstead, Sherbrooke, Richmond and Compton comprise an area of approximately 2,200 square miles or 1,410,200 acres. The topography varies from the level areas along the stream courses to the rough, broken hills of the mountainous part of the area, with a range in elevation from 523 feet at Lake Massawippi to 3,500 feet above sea level on Megantic mountain. In general the country slopes from the International Boundary on the south and east towards the north and northwest. The area is crossed in a northeasterly direction by three distinct and roughly parallel ridges about 25 miles apart and is dissected by numerous rivers, all of which flow towards the north. The St. Francis is the largest river in the area and with its tributaries, drains practically the whole region, while numerous lakes scattered throughout the area tend to modify the climate in some localities.

The country was first settled by immigrants from the United States toward the latter part of the eighteenth century and since then it has developed rapidly. Originally the four counties were covered with forest of yellow birch, grey birch, maple and beech on the higher slopes and a mixture of hemlock, white pine, oak, birch, spruce, cedar and poplar on the lower slopes, but much of this has been cleared and little of the original forest is left.

The climate of the area is humid temperate. Long cold winters with heavy snowfalls are followed by summers in which the days and nights have slight variations in temperature and this is accompanied by an abundance of rainfall, which averages about 40 inches per annum. All of the area was at one time under a great continental ice sheet which crushed the rock materials and carried and re-distributed them throughout the area. These materials chiefly consist of slates and shales containing some impure limestone, schists, granite and gneiss. The soils developed on the slaty and shaly areas have a gently rolling to level topography, those developed on schistose materials a strongly rolling to hilly topography and those developed on granite and gneiss material have a rough, broken topography. Over practically the whole area, the soils belong to the Podsol group. They are heavily leached soils with a greyish A_2 horizon under the forest duff and a reddish brown to brown B horizon in which the accumulation and deposition of the leached products takes place. In the western part of the area, particularly in western Richmond county, the soils show a tendency to be less leached and the brown colour is carried down deep into the profile. These soils are in a state of transition to the Brown Podsolic soils which occur farther west. About 75 per cent of the soils of the area are

developed on glacial till, with 47 per cent occupied by the well-drained soils, 21 per cent by the imperfectly-drained soils and about 7 per cent occupied by poorly-drained types. The soils developed on outwash materials occupy about 7 per cent, lacustrine soils about 3 per cent, and the soils of the bottom lands about 2·5 per cent of the surveyed area. Nearly 7 per cent of the area is in rough stony land unsuitable for agricultural purposes and 3 per cent is in swamp.

Since the early days of settlement, mixed farming and lumbering have been the leading occupations of the farm population. In Compton county the raising of cattle for beef was formerly more profitable than dairy farming, but in recent years more cows are being milked. The recent establishment of an evaporated milk plant at Sherbrooke has provided a good market for milk in the area and the war situation has caused a decided increase in the production of butter and cheese. Pasture management is rapidly becoming an important factor in successful farming in this area. The fertility of most of the pasture land has been seriously depleted through lack of care and under-grazing and much of the present pasture land should be returned to forest. On the remainder, proper grazing methods and the use of fertilizer will be of advantage.

The leading crops are hay, usually composed of timothy and red top, and grain. Oats occupy the largest acreage of grain crops, but there is considerable area under mixed grains. Small acreages of fodder corn, potatoes, roots, clover, rye and buckwheat are also grown. About 50 per cent of the land in farms is improved, the remaining 50 per cent being in natural pasture or woodland.

The soils of the area were classified into twenty-one series based on difference in parent material, drainage and mode of formation. The distribution and area of these soils is shown on the map accompanying this report.

In general, the best developed agriculture of the area is seen on the Greensboro soils in Stanstead county, although there are several areas of the other types which are equally well developed. The well-drained upland soils vary in texture from loams to sandy loams. The Berkshire, Racine, Ascot and Sherbrooke soils are cultivated to a large extent, but do not have the productivity of the Greensboro soils. The Calais, Magog, Brompton and Orford soils are all suitable for grass and good crops of grain have been grown on the Magog soils when drainage is improved. The Dufferin soils will grow good grass crops where surface drainage is not impeded and much of this type has been developed in Stanstead and Compton county. The soils developed from outwash materials are found along the river valleys and the Coaticook and Sheldon soils are most developed. The Coaticook clay loam is suitable for the production of grain, hay and root crops and many dairy farms are found on this type of soil, while the Shipton soils, which are found on the terraces in Richmond county, are not highly developed, but are commonly used for hay. The Colton and St. Francis soils are best suited to truck crops and fertilizer must be applied to these soils in order to get a profitable crop. Hay and grain usually give poor yields, unless fertilized. The Danby soils are used as a source of gravel for road construction, while the Milby soils, together with some of the recent alluvial deposits, are used chiefly for hay and grain, but unfortunately they are subject to flooding and early frosts and are suitable only for short season crops.

Little or no attention has been given to soil erosion by the farming population or other agencies in the area and many of the soils, particularly those of the Coaticook, Sheldon and Calais series, are being rapidly eroded and a certain amount of sheet washing is also taking place on the other types. It will not be long before this erosion will need attention to prevent losses of valuable farm land.

There is little difference in the chemical composition of the soils of the area except where the underlying material exerts a direct influence on the soil. Nearly all of the soils are acid and the addition of lime is needed, while

phosphorus has been amply demonstrated to be the most important single element lacking in the soils of the area. About 10 per cent of the area is not fit for agricultural purposes due to stoniness or rough topography. The Magog and Brompton soils are the stoniest, but they may be cultivated. The other soils except those of the Coaticook, St. Francis, Colton, Sheldon, Shipton and Lennoxville contain some stone, but not enough to interfere with cultivation. The soils of the swamps are difficult to drain and are not used for agricultural purposes.

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TABLE XIII.—CHEMICAL AND PHYSICAL COMPOSITION OF SOIL SAMPLES FROM THE SURVEYED AREA

				Chemical Analysis										Physical Analysis			
Horizon	Depth in inches	Loss on ignition %	pH	Lime requirement lb. CaO per acre	Avail P_2O_5 p.p.m.	Avail K_2O p.p.m.	Total N %	Total P_2O_5 %	Total K_2O %	Total CaO %	Total MgO %	Total SiO_2 %	Total R_2O_3 %	Gravel <1 mm %	Sand 1–·05 mm %	Silt ·05–·005 mm %	Clay >·005 mm %
Greensboro loam																	
A_1........	1 – 2	16·75	6·0	9,360	5·2	90·0	0·59	*a* 0·25 *b* 0·30	0·70 0·84	0·49 0·59	1·53 1·84	68·90 82·90	11·48 13·80	20·0	44·8	43·0	12·2
A_2........	2 –4	1·62	5·6	2,880	3·2	22·0	0·14	*a* 0·13 *b* 0·14	1·18 1·20	0·25 0·26	1·46 1·48	88·00 89·40	9·42 9·56	17·0	36·8	48·0	15·2
B_1........	4 – 8	11·75	5·0	8,640	5·9	39·0	0·29	*a* 0·23 *b* 0·26	1·48 1·68	0·36 0·41	1·39 1·58	67·30 75·10	18·75 21·28	10·0	52·4	38·0	9·6
B_2........	8 –26	9·50	5·7	5,400	10·3	37·0	0·28	*a* 0·25 *b* 0·28	1·47 1·62	0·36 0·40	1·64 1·81	70·90 77·35	20·80 22·95	16·0	57·2	34·0	8·8
C.........	26	3·00	6·2	1,440	24·3	74·0	0·13	*a* 0·17 *b* 0·18	1·73 1·78	0·45 0·46	1·39 1·43	75·00 77·25	20·51 21·15	40·0	43·6	33·2	23·2
*A........	0 – 2	14·14	4·7	7,886	15·6	222·0	0·45	*a* 0·23 *b* 0·27	1·63 1·90	0·43 0·50	1·33 1·55	68·60 80·00	13·02 15·20	8·0	40·0	47·0	13·0
B_1........	2 – 8	10·57	5·0	6,134	9·1	490·0	0·25	*a* 0·24 *b* 0·27	1·45 1·62	0·36 0·40	1·47 1·64	65·40 73·10	19·26 21·53	10·0	50·4	41·6	8·0
B_2........	8 –20	6·79	5·3	2,629	14·2	185·0	0·15	*a* 0·21 *b* 0·22	1·44 1·54	0·60 0·64	1·31 1·40	68·70 73·70	18·23 19·57	23·0	44·0	46·0	10·0
C.........	20 –	2·84	5·3	1,314	15·1	90·0	0·06	*a* 0·20 *b* 0·20	1·83 1·88	0·42 0·43	1·65 1·69	73·30 75·30	18·20 18·70	14·0	48·0	36·0	16·0
Greensboro loam—strongly rolling phase																	
A_0........	0 –2½	49·00	4·2	28,440	35·7	25·70	1·19	*a* 0·32 *b* 0·63	0·60 1·18	0·70 1·37	0·87 1·71	43·60 85·50	3·95 7·75	10·0	68·0	26·4	5·6
A_2........	2½– 4	1·65	4·6	2,160	3·9	30·0	0·09	*a* 0·13 *b* 0·13	1·09 1·11	0·24 0·24	0·86 0·87	89·10 90·80	9·09 9·25	16·0	43·2	43·2	13·6
B_1........	4 – 7	11·80	4·8	11,520	9·1	72·0	0·22	*a* 0·25 *b* 0·28	1·56 1·77	0·31 0·35	0·90 1·02	68·50 77·80	17·88 20·28	17·0	59·4	31·8	8·8
B_2........	7 –20	8·13	5·2	5,760	7·3	68·0	0·15	*a* 0·22 *b* 0·25	1·43 1·56	0·36 0·39	1·02 1·11	71·75 78·10	16·93 18·43	26·0	48·4	37·2	14·4
C.........	20 –	2·61	6·2	1,440	20·7	92·0	0·11	*a* 0·22 *b* 0·23	1·68 1·72	0·46 0·47	0·82 0·84	75·80 77·90	18·58 19·10	18·0	44·2	35·0	20·8

TABLE XIII.—CHEMICAL AND PHYSICAL COMPOSITION OF SOIL SAMPLES FROM THE SURVEYED AREA—*Continued*

						Chemical Analysis									Physical Analysis		
Horizon	Depth in inches	Loss on ignition %	pH	Lime requirement lb. CaO per acre	Avail P_2O_5 p.p.m.	Avail K_2O p.p.m.	Total N %	Total P_2O_5 %	Total K_2O %	Total CaO %	Total MgO %	Total SiO_2 %	Total R_2O_3 %	Gravel <1 mm %	Sand 1–·05 mm %	Silt ·05–·005 mm %	Clay >·005 mm %
Calais loam																	
A.........	½– 6	18·39	6·1	2,629	16·5	119·0	0·73	*a* 0·32 *b* 0·39	1·51 1·85	0·70 0·86	1·01 1·24	61·35 75·20	16·03 19·65	0·5	42·0	46·0	12·0
B.........	6 –15	2·26	6·7	2,629	107·5	55·0	0·12	*a* 0·31 *b* 0·31	1·45 1·46	0·69 0·70	1·17 1·18	78·40 79·30	16·41 16·73	27·0	41·4	42·6	16·0
C.........	15 –	2·88	7·0	0	243·0	109·5	0·07	*a* 0·36 *b* 0·37	1·60 1·62	0·69 0·70	1·31 1·32	75·75 76·50	17·29 17·50	10·0	36·0	40·0	24·0
Dufferin sandy loam																	
A_0........	0 – 3	70·70	5·4	17,529	31·0	109·0	2·07	*a* 0·27 *b* 0·92	1·00 3·41	4·30 14·64	1·26 4·30	15·83 54·00	7·03 24·02	Organic material			
A_2........	3 – 6	2·74	5·6	1,314	68·6	34·0	0·13	*a* 0·13 *b* 0·14	1·68 1·72	0·80 0·82	0·80 0·90	79·95 82·10	12·87 13·25	9·0	35·6	48·0	16·4
B_2........	6 –15	1·18	6·1	0	160·5	34·0	0·05	*a* 0·11 *b* 0·12	1·49 1·51	0·69 0·70	1·04 1·05	81·35 82·50	13·69 13·89	6·0	45·6	39·6	14·8
C.........	15 –	1·03	6·7	0	371·0	34·0	0·04	*a* 0·16 *b* 0·17	1·54 1·55	0·96 0·97	1·04 1·05	82·00 82·90	14·70 14·85	3·0	37·6	51·0	11·4
Berkshire loam																	
A_0........	0 – 1½	26·23	5·4	13,129	15·3	147·0	0·83	*a* 0·19 *b* 0·26	0·89 1·21	1·20 1·63	1·29 1·75	59·21 80·30	12·76 17·30	5·0	55·6	37·6	6·8
A_2........	1½– 2½	5·99	5·2	5,140	10·8	17·0	0·20	*a* 0·12 *b* 0·13	0·83 0·88	0·62 0·66	0·90 0·95	76·69 81·69	15·08 16·66	10·0	47·2	40·4	12·4
B_1, B_2.....	2½–15	6·24	5·8	6,609	9·3	17·0	0·24	*a* 0·19 *b* 0·20	0·93 0·99	0·80 0·85	1·29 1·38	70·56 75·20	18·39 19·62	25·0	46·2	45·4	8·4
B_3........	15 –25	3·72	6·3	4,406	17·4	15·0	0·11	*a* 0·13 *b* 0·14	0·79 0·82	0·87 0·90	1·45 1·51	74·61 76·50	16·99 17·62	25·0	47·2	40·8	12·0
C_1........	25 –30	2·46	6·5	2,203	14·4	16·0	0·04	*a* 0·12 *b* 0·13	0·90 0·92	0·89 0·90	1·88 1·92	75·59 77·55	17·03 17·45	32·0	53·0	34·0	13·0
C_2........	30 –	1·80	6·8	1,469	14·4	16·0	0·01	*a* 0·12 *b* 0·13	0·79 0·81	1·03 1·05	2·88 2·93	75·44 76·90	17·17 17·47	31·0	54·0	31·0	15·0
*A........	0 – 2	10·44	4·9	5,257	20·2	73·0	0·32	*a* 0·09 *b* 0·10	1·32 1·47	0·78 0·87	1·86 2·07	76·20 85·10	13·62 15·32	14·0	45·6	42·4	12·0
B_1........	2 –12	5·38	4·8	5,257	15·1	41·0	0·15	*a* 0·09 *b* 0·10	1·37 1·45	0·71 0·75	2·35 2·48	72·60 76·75	15·85 16·76	17·0	49·2	36·8	14·0

B₂........	12 –18	4·55	5·2	3,505	18·3	29·0	0·12	a 0·10 b 0·11	1·49 1·56	0·73 0·76	2·76 2·89	73·70 77·20	15·94 16·70	18·0	50·2	35·8	14·0
C.........	18 –	1·33	6·0	....	131·5	51·0	0·09	a 0·14 b 0·14	1·49 1·51	1·25 1·27	2·96 2·99	74·60 75·60	17·76 18·00	16·0	51·2	29·2	19·1
Orford sandy loam																	
A₀........	0 – 1½	69·57	4·8	30,110	36·7	....	1·51	a 0·18 b 0·59	0·80 2·63	1·09 3·58	1·15 3·78	23·70 77·88	5·72 18·79	2·0	57·2	38·4	4·4
A₂........	1½– 2½	3·93	4·8	8,078	8·3	52·0	0·05	a 0·03 b 0·03	0·71 0·74	0·62 0·65	1·06 1·10	84·97 88·50	9·80 10·02	14·0	41·2	43·2	15·6
B₁........	2½– 5	4·10	4·9	7,344	4·8	33·0	0·12	a 0·06 b 0·07	0·83 0·86	0·86 0·89	1·67 1·74	77·67 80·90	16·47 17·15	33·0	41·2	44·4	14·4
B₂........	5 –15	1·46	6·4	1,469	30·7	10·0	0·04	a 0·08 b 0·09	0·74 0·76	0·95 0·97	2·33 2·37	79·38 80·75	15·27 15·52	35·0	49·2	40·4	10·4
B₃........	15 –25	1·36	6·8	734	66·0	19·0	0·04	a 0·13 b 0·14	0·85 0·86	1·17 1·19	3·64 3·70	72·34 73·50	17·74 18·02	44·0	59·0	28·6	12·4
C.........	2 5	0·92	6·8	....	77·9	19·0	0·01	a 0·11 b 0·12	0·89 0·90	1·24 1·25	1·85 1·86	74·44 75·25	21·74 22·00	26·0	62·2	27·8	10·0
Racine sandy loam																	
A₀........	0 – 1	59·53	4·4	26,438	9·3	295·0	1·49	a 0·19 b 0·47	0·60 1·48	0·80 1·98	1·39 3·43	32·15 79·35	5·29 13·08	5·0	68·2	25·8	6·0
A₂........	1 – 2	1·96	4·6	5,140	2·7	34·0	0·06	a 0·03 b 0·03	0·90 0·92	0·41 0·42	1·33 1·36	86·03 87·80	9·63 9·83	17·0	45·6	35·4	19·0
B₁, B₂	2 – 8	14·25	4·4	17,625	3·4	97·0	0·34	a 0·10 b 0·11	1·28 1·49	0·63 0·73	1·61 1·88	64·67 75·60	17·53 20·50	16·0	51·6	38·4	10·0
B₃........	8 –20	7·44	4·9	6,609	3·4	47·0	0·18	a 0·12 b 0·13	1·18 1·28	0·83 0·90	1·85 2·00	70·15 76·00	18·58 20·02	25·0	43·6	46·8	9·6
C.........	20 –	1·82	6·6	1,469	14·8	29·0	0·05	a 0·13 b 0·14	1·36 1·38	0·90 0·92	1·81 1·84	74·80 76·15	19·54 19·90	24·0	43·6	38·4	18·0
Brompton stony loam																	
A₁........	0 – 5	20·00	5·0	11,750	3·4	149·0	0·54	a 0·15 b 0·18	1·72 2·21	0·64 0·80	1·23 1·54	59·50 73·75	17·36 21·70	10·0	41·2	44·8	14·0
A₂........	5 –12	3·48	5·2	3,672	3·4	55·0	0·09	a 0·07 b 0·07	1·53 1·58	0·67 0·69	1·56 1·61	73·53 76·10	16·62 17·22	35·0	40·8	47·2	12·0
B.........	12 –20	1·97	6·3	734	4·1	27·0	0·06	a 0·12 b 0·13	2·03 2·07	0·77 0·79	2·04 2·08	71·49 73·00	20·30 20·73	25·0	46·6	38·6	14·8
C.........	20 –	1·57	6·8	734	18·2	54·0	0·01	a 0·17 b 0·17	1·77 1·80	0·93 0·94	2·05 2·08	72·16 73·10	23·91 24·28	25·0	43·6	39·6	16·8

TABLE XIII.—CHEMICAL AND PHYSICAL COMPOSITION OF SOIL SAMPLES FROM THE SURVEYED AREA—*Continued*

		Chemical Analysis												Physical Analysis			
Horizon	Depth in inches	Loss on ignition %	pH	Lime require-ment lb. CaO per acre	Avail P_2O_5 p.p.m.	Avail K_2O p.p.m.	Total N %	Total P_2O_5 %	Total K_2O %	Total CaO %	Total MgO %	Total SiO_2 %	Total R_2O_3 %	Gravel <1 mm %	Sand 1-·05 mm %	Silt ·05-·005 mm %	Clay >·005 mm %
Ascot sandy loam																	
A_0.........	0 – 2	23·00	4·7	7,010	26·6	171·0	0·72	*a* 0·27 *b* 0·35	1·17 1·52	0·84 1·09	0·92 1·20	65·80 85·50	8·10 10·53	7·0	54·0	39·5	6·5
A_2.........	2 – 4	3·57	4·8	4,381	19·2	35·0	0·17	*a* 0·13 *b* 0.14	1·19 1·23	0·49 0·51	0·83 0·86	85·20 88·20	10·47 10·87	7·0	40·0	51·2	8·8
B_1.........	4 –12	5·57	4·8	6,572	23·8	36·0	0·24	*a* 0·26 *b* 0·27	1·34 1·42	0·72 0·76	1·55 1·69	75·65 80·11	17·39 18·45	10·0	42·8	48·4	8·8
B_2.........	12 –20	4·82	5·0	3,067	27·0	40·0	0·12	*a* 0·16 *b* 0·17	1·41 1·48	1·02 1·07	2·75 2·87	76·80 80·60	18·07 18·97	18·0	52·8	36·4	10·8
C.........	20 –	2·32	5·8	876	183·0	65·0	0·06	*a* 0·15 *b* 0·15	1·57 1·61	1·74 1·79	2·60 2·67	78·80 80·67	17·20 17·65	24·0	45·8	35·2	19·0
Sherbrooke sandy loam																	
A_0.........	0 – 1½	35·63	4·7	22,032	46·0	297·0	1·18	*a* 0·21 *b* 0·33	0·86 1·34	0·57 0·89	1·05 1·63	54·10 84·00	7·58 11·77	9·0	59·6	36·8	3·6
A_2.........	1½– 3	1·72	4·8	4,406	7·4	21·0	0·07	*a* 0·04 *b* 0·04	1·14 1·16	0·41 0·42	0·86 0·87	85·09 86·50	9·90 10·00	14·0	33·6	47·8	18·6
B_1.........	3 – 8	8·47	4·7	7,344	18·7	36·0	0·27	*a* 0·24 *b* 0·26	1·11 1·21	0·56 0·61	1·43 1·57	71·32 78·00	15·15 16·58	15·0	33·6	56·6	9·8
B_2.........	8 –18	4·97	5·0	4,406	10·0	44·0	0·12	*a* 0·13 *b* 0·14	1·07 1·13	0·64 0·67	1·41 1·48	73·50 77·40	16·41 17·25	17·0	37·6	45·6	16·8
C_1.........	18 –24	1·81	6·0	734	7·0	51·0	0·01	*a* 0·01 *b* 0·01	1·12 1·14	0·64 0·65	1·26 1·28	75·89 77·10	16·63 16·90	20·0	40·2	38·0	21·8
C_2.........	24	2·11	6·4	....	12·5	85·0	0·01	*a* 0·11 *b* 0·11	1·69 1·72	0·63 0·64	1·45 1·48	74·67 76·00	20·02 20·40	17·0	33·4	37·6	29·0
Magog stony loam																	
A_1.........	0 – 2	9·32	5·1	2,505	21·1	123·0	0·33	*a* 0·20 *b* 0·22	1·58 1·75	0·81 0·90	1·60 1·77	76·80 84·80	11·02 12·17	18·0	45·2	38·0	16·8
A_2.........	2 – 8	2·13	5·1	2,190	16·9	58·0	0·07	*a* 0·13 *b* 0·13	1·51 1·54	1·00 1·02	1·85 1·90	84·60 85·15	13·42 13·47	23·0	45·2	32·0	22·8
B_1.........	8 –20	2·00	5·4	876	77·8	57·0	0·10	*a* 0·21 *b* 0·22	1·60 1·63	1·01 1·03	2·63 2·69	77·80 79·50	16·69 17·05	29·0	52·0	30·0	18·0
B_2.........	20 –	2·05	6·0	....	254·2	95·0	0·06	*a* 0·27 *b* 0·27	1·67 1·70	1·17 1·19	2·33 2·38	72·72 74·20	20·53 20·95	18·0	46·2	28·0	25·8

Colton fine sandy loam																	
*A........	0 – 7	5·16	5·1	4,381	17·4	34·0	0·17	*a* 0·11 *b* 0·12	1·12 1·18	0·85 0·90	1·63 1·72	75·90 80·15	12·44 13·14	5·0	78·8	16·4	4·8
B........	7 –22	1·43	5·2	1,752	22·4	9·0	0·05	*a* 0·09 *b* 0·09	1·05 1·07	0·83 0·84	1·96 1·99	78·55 79·65	13·62 13·82	4·0	86·0	12·2	1·8
C........	22 –	0·30	5·5	876	30·7	12·0	0·03	*a* 0·10 *b* 0·10	1·32 1·32	0·82 0·83	1·76 1·77	81·60 81·90	12·45 12·50	2·0	94·0	5·2	0·8
Shipton sandy loam																	
*A........	0 – 4	9·96	5·2	4,416	23·6	131·0	0·35	*a* 0·19 *b* 0·21	1·06 1·18	0·71 0·79	1·08 1·20	69·71 77·40	19·93 22·13	19·0	57·2	37·6	5·2
B_1........	4 –14	7·70	5·4	3,672	15·2	88·0	0·19	*a* 0·23 *b* 0·25	1·01 1·10	0·82 0·89	1·04 1·13	68·61 74·75	22·05 23·95	9·0	58·8	36·0	5·2
B_2........	14 –36	5·25	5·6	2,938	6·3	154·0	0·10	*a* 0·15 *b* 0·16	0·97 1·02	0·90 0·95	1·04 1·10	71·00 75·00	21·85 23·08	8·0	56·8	34·0	9·2
B_3........	36 –50	1·75	6·6	....	16·5	149·0	0·04	*a* 0·18 *b* 0·18	0·98 1·00	1·16 1·18	1·34 1·36	75·04 76·40	19·79 20·15	0·0	50·0	38·4	11·6
Sheldon sandy loam																	
*A........	0 – 4	7·11	5·2	2,880	14·6	54·0	0·06	*a* 0·24 *b* 0·26	1·30 1·40	0·64 0·69	0·54 0·58	75·00 80·70	13·36 14·38	0·0	58·8	30·4	10·8
B_1........	4 –15	5·28	5·6	2,160	7·3	29·0	0·09	*a* 0·12 *b* 0·13	1·39 1·47	0·46 0·49	0·52 0·55	77·65 82·00	15·30 16·17	1·0	55·6	32·8	11·6
B_2........	15 –20	2·15	6·0	360	14·6	27·0	0·08	*a* 0·11 *b* 0·11	1·18 1·20	0·57 0·58	0·68 0·69	82·20 84·00	14·66 14·98	0·0	59·6	30·8	9·6
B_3........	20 –36	1·26	6·2	....	14·9	29·0	0·07	*a* 0·14 *b* 0·14	1·07 1·08	0·70 0·71	0·67 0·68	83·80 84·70	12·61 12·77	0·0	63·6	28·8	7·6
D........	36 –	2·85	6·6	864	25·8	72·0	0·08	*a* 0·13 *b* 0·13	1·90 1·96	0·44 0·45	0·98 1·01	72·35 74·50	21·32 21·97	0·0	21·6	46·8	31·6
Coaticook clay loam																	
A_0........	0 – 1	55·20	4·5	30,240	30·1	62·0	1·17	*a* 0·38 *b* 0·85	0·58 1·29	0·73 1·63	1·75 3·90	33·23 74·17	9·16 20·12	0·0	56·4	34·8	8·8
A_2........	1 – 3	1·70	5·0	3,600	4·2	62·0	0·08	*a* 0·19 *b* 0·19	1·19 1·21	0·46 0·47	1·33 1·35	87·20 88·08	9·33 9·46	0·0	30·4	50·4	19·2
B_1........	3 –15	7·27	5·0	8,640	4·5	81·0	0·29	*a* 0·23 *b* 0·25	1·37 1·47	0·57 0·61	0·95 1·02	72·00 77·60	18·22 19·67	0·0	35·6	45·2	19·2
B_2........	15 –26	2·06	5·8	720	28·7	60·0	0·13	*a* 0·24 *b* 0·24	1·77 1·80	0·56 0·57	1·37 1·40	77·30 78·90	16·88 17·22	0·0	35·6	41·2	23·2
C........	26 –	3·72	6·6	....	168·2	124·0	0·11	*a* 0·38 *b* 0·39	2·33 2·41	0·69 0·71	1·56 1·62	69·35 71·80	22·77 23·60	0·0	15·6	40·8	43·6

* = cultivated samples from old pastures.
a = whole soil, oven-dried at 110° C.
b = whole soil calculated to mineral constituents only.

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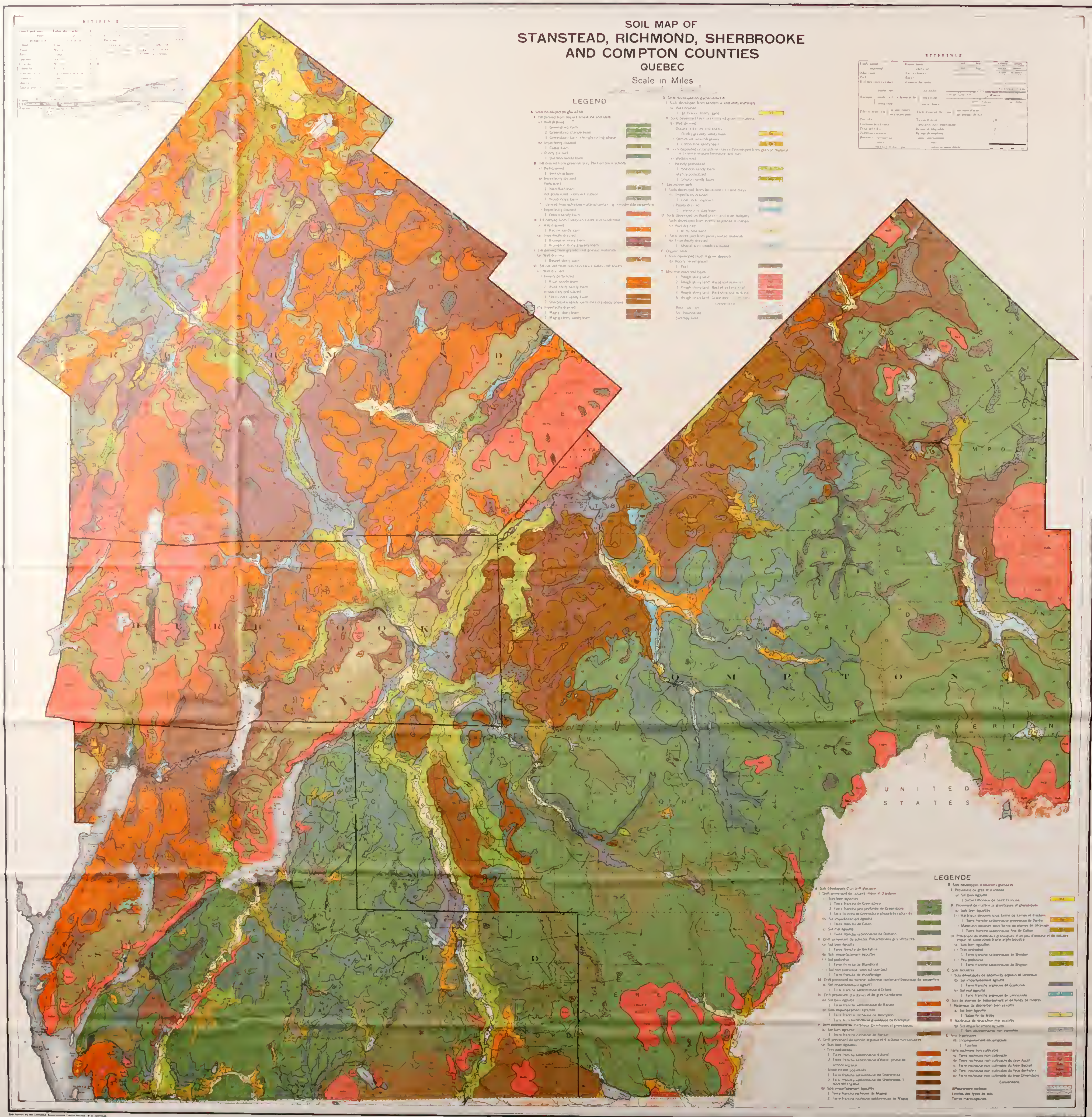
SOIL MAP OF
STANSTEAD, RICHMOND, SHERBROOKE
AND COMPTON COUNTIES
QUEBEC
Scale in Miles
LEGEND
LEGENDE
UNITED
STATES

OTTAWA
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